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COLOGNE VIBRATOR.

Send no money. Have your banker or any responsible firm with a commercial rating notify us to ship you the Cologne vibrator with the double vibrating handles on one side and oscillating on on the other, on 30 days trial with the understanding that if you find it equal in every respect to other vibrators now sold for $100 or over, send us **$45** for the 110 direct current or **$47.50** for the 110 volt 60 cycle, alternating current vibrator, but should you not find the Cologne vibrator equal to other vibrators now sold at $100, you are to return the vibrator by freight at our expense to Hammond, Indiana and you owe us nothing.

PREFACE

THE preparation of this book was undertaken with a three-fold purpose. First, to indicate in an entirely conservative way what might be reasonably expected from the application of mechanical vibration in the treatment of disease. Second, by briefly outlining well-established principles in physiology and indicating the relationship which this treatment is susceptible of sustaining towards them, to establish a systematic basis for its application that is both rational and scientific and which shall commend it to the favorable reception and impartial investigation of the medical profession. Third, to so state the principles and illustrate their practical application as to make treatment by means of mechanical vibration available and effective for the busy practitioner with the least possible expenditure of time on his part. The work is now submitted to the favor of the profession with the hope that this purpose has been met. If the following pages shall even measurably meet and fulfill the purpose as above indicated, the author will feel

Plate I.

Frontispiece.

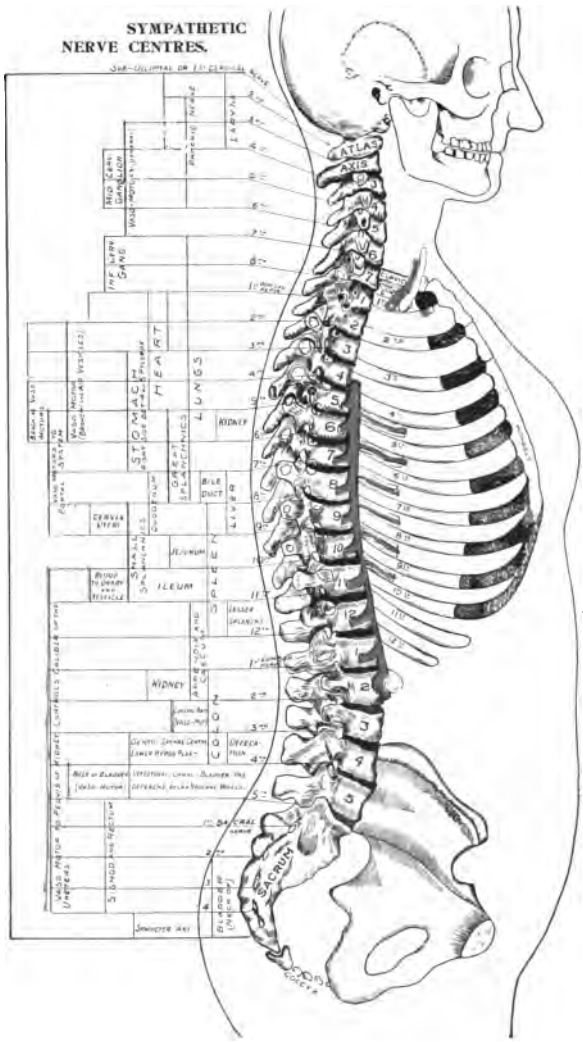

Diagram showing areas in the spinal cord from which the nerves controlling the various organs and parts of the body are given off.

(The red lines in Table indicate vaso-motor areas. Stimulation of the centres indicated in the diagram will affect the organs controlled by them, as per Table at the left of diagram.)

MECHANICAL VIBRATORY STIMULATION

ITS THEORY AND APPLICATION IN THE TREATMENT OF DISEASE

BY

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of the nerve-centres controlling the various viscera and functions of the body, little difficulty need be experienced in quickly deciding how to properly treat a particular disease.

It is to be hoped that any physician sufficiently interested in this new therapy as to be led to investigate it at all, will do it *thoroughly. It is not claimed to be a "cure-all," or that it is destined to supersede and render all other forms of treatment valueless.* Nevertheless, there is a substantial scientific basis for its selection and application, and better results are sure to accrue to the practitioner who first thoroughly familiarizes himself with its basic principles and the *rationale* of its action, before attempting to apply the treatment. It is earnestly hoped that the following pages may be of assistance in the accomplishment of that object.

In conclusion, it may be pertinent to remark that this book is prepared solely in the interest of the *principles* that it is believed should govern the application of mechanical-vibratory stimulation, *and not for the purpose of exploiting the merits of a particular method, or an instrument.* A correct method and an efficient instrument are both essential to the highest success; but these points must be determined alone by the individual judgment and preference of the practitioner.

CHAPTER II

MECHANICAL VIBRATION

BEFORE proceeding to consider, as will be done in the succeeding chapters, the various physiological functions and the intimate and natural relationship which vibratory treatment sustains to them, it will be well to briefly inquire (1) what mechanical vibration is; (2) what it is susceptible of accomplishing; and (3) the *modus operandi* of its therapeutic action.

First. *Vibration* is produced by heavy pressure. *Stimulation* is a modification of vibration, and is produced by light pressure. *Vibratory stimulation* is pressure midway between light and heavy. It can be applied crudely by the tips of the fingers or thumbs. But as there are so many mechanical devices now manufactured for the purpose, the most of them possessing more or less merit, and all of them probably superior to the fingers, it is scarcely worth expending the time necessary to describe the technique of the manual method. Nevertheless, the manual method is really vibration, although it lacks some of the essential elements

found in the mechanical form. Pressure exerted upon a nerve causes it to vibrate, or increases its natural impulse. (See Landois & Stirling's text-book of Physiology.) But any of the mechanical devices constructed for this purpose, that *admit of the localization of nerve pressure* are far preferable to the manual method. An instrument not so constructed as to permit of localized treatment, is fatally defective in principle and had better not be employed. Except in a limited number of abnormal physical conditions, general vibration of the entire body is neither desirable nor beneficial. An instrument for applying mechanical stimulation or vibration should be so constructed as to permit of the ready adjustment of the stroke from a short to a long one. The difference between vibration and *vibratory stimulation,* consists in the length of the stroke and in the degree of pressure exerted rather than in the rapidity of the vibrations themselves. This fact should be kept in mind and the length of the stroke decided upon only after examination of a given case and before treatment is actually applied.

Vibration, as has already been seen, is produced by a long stroke and heavy pressure, and is applied directly over the engorged or congested organ or part which it is desired

to relieve. A longer stroke and still heavier pressure, applied over a nerve for a sufficient length of time, will produce *inhibition.*

Stimulation is produced by a medium stroke and light pressure. This will usually be the degree of treatment most desirable for those cases in which increased nutrition and a larger blood supply to a given organ or part, is desired.

Vibratory stimulation, as already pointed out, is a combination of the two degrees of treatment, and will frequently be found desirable in cases of pronounced visceral inaction or atony.

Second. Treatment by mechanical-vibratory stimulation has been found by practical experiment to be capable of:

(1) Increasing the volume of the blood and lymph flow to a given area or organ;
(2) Increasing nutrition;
(3) Improving the respiratory process and functions;
(4) Stimulating secretion;
(5) Improving muscular and general metabolism, and increasing the production of animal heat;
(6) Stimulating the excretory organs and assisting the functions of elimination;

(7) Softening and relieving muscular contractures;

(8) Relieving engorgement and congestion;

(9) Facilitating the removal through the natural channels of the lymphatics, of tumors, exudates and other products of inflammation; relieving varicosities, and dissipating eruptions.

(10) Inhibiting and relieving pain.

It is scarcely necessary, perhaps, to repeat the statement made in the preceding chapter, that treatment by mechanical-vibratory stimulation is not claimed to be a "*cure-all*" or an exclusive antidote for every abnormal physical condition. Nevertheless, the foregoing epitome may, perhaps, strike the reader as comprehending about every condition that a physician will ever be called upon to treat. It is only fair to say, however, that experience warrants us in expecting more or less of these results from this treatment. They cannot, of course, be expected to be uniform or invariable; otherwise the riddle of the universe would be solved, and the dissolution of the physical body might be indefinitely postponed. What it is desired here to say is this: that for the purpose of effecting the changes

above enumerated, there are no physical therapeutic agents within the writer's experience or knowledge that will render as effective service along these lines, *with as few disappointments,* as mechanical stimulation, *properly employed.* All that is requested of the skeptical reader is that he shall submit his doubts to the crucible of experimentation, conducted in accordance with the principles and in the manner to be hereinafter indicated. If that course shall be intelligently and conscientiously pursued, the claims for this treatment, as outlined above, will not be thought to have been exaggerated or its capabilities overestimated.

Third. The *modus operandi* of the therapeutic effects of mechanical vibration will, it is hoped, be clearly indicated in the succeeding chapters. *The general theory upon which this treatment is based is that all the functions and organs of the body are controlled by certain nerves or nerve centres, located principally in the spinal cord, and that in the course of disease, if these centres are reached and treated, restoration to normal action may be expected in most cases to take place.*

As already stated in the previous chapter, in order to show more clearly that the treatment is rational and scientific because in ac-

cord with sound physiological principles, it is proposed, in the following chapters, briefly to outline the physiology of the principal functions of the body. It is believed that with these principles clearly in mind and considered in connection with this treatment, a more intelligent and satisfactory comprehension of the *rationale* of its application becomes possible and better results may consequently be expected in practice.

CHAPTER III

THE BLOOD

It is not proposed in this chapter, to go deeply into the physiology of the blood and its circulation. The brief consideration of the subject now contemplated, is rather for the purpose of presenting, in general outline, the leading facts upon which all physiologists are agreed, with a view of indicating thereby more clearly how mechanical-vibratory stimulation affects the diseased organism.

As is well known, the character and composition of the blood is constantly varying in different parts of the body and at different times. That flowing through the capillaries is, under normal conditions, a colorless fluid or plasma in which are carried a number of bodies,—red and white corpuscles. Outside the capillary walls and cells or fibres filling such spaces as exist between the capillary walls and the cells or fibres of the tissue, or between the elements of the tissues themselves, is found another fluid, colorless, resembling in many respects blood plasma, called *lymph*. All the elements of the tissues and outer part of the

capillaries, are saturated with lymph which is constantly passing from the tissues, along special channels, into the lymphatic vessels and thence into the blood.

In the course of the blood-flow through the capillaries, certain elements of the plasma pass through their walls into the lymph vessels, and certain properties of the lymph, on the other hand, pass through the wall of the capillaries into the blood that is within them. Thus is maintained an interchange of material between the blood within and the lymph outside, the capillaries. The same interchange goes on between the lymph and the tissues. Sir Michael Foster calls lymph the " middleman " by means of which a double interchange of material takes place between the blood within the capillaries and the tissues outside of it. A double stream is maintained as long as the processes of life are carried on. A stream passes from the blood to the tissues and another stream from the tissues to and into the blood. It is this stream constantly passing from blood to tissue that performs the work of sustenance and repair to the body. It is thus that oxygen is conveyed to its various parts. The waste products of the tissues or the products of chemical change, thus find their way into the blood. It is to be remem-

bered that not all these products are waste matter. Some of them may be products no longer needed in one tissue but necessary in some other; or, again, a particular tissue may elaborate regularly certain products required for the tissue of some other part of the body. But these products can only reach their point of destination through the "stream" already referred to. There is still another stream to be considered, which is analogous to the double blood stream. That is the *lymph stream.* Its function is to carry away from the tissues the material received from the blood but which is not taken up by it, or tissue material broken down or otherwise disintegrated, and which does not readily pass into the blood vessels.

The bearing of this brief recapitulation of these elementary principles upon the subject of which this book is designed especially to treat, will become more apparent, it is expected, when the mechanism and functions of the muscular system are considered in a subsequent chapter. For the present, then, it is sufficient to say that the capillary network in most of the tissues, particularly in muscular tissue, is closely packed to the blood vessels. The muscular fibre and the capillaries may indeed be so close to a blood vessel that the lymph between them is exceedingly thin; or, again,

they may be so far away — the blood vessels lying outside of a large mass of tissue — as to necessitate the interchanges through lymph passages of considerable length. The point that it is here desired to emphasize is not so much that the tissues live on the blood, but that they do so largely by the *aid of the lymph* — that without this help, the tissues could not be sustained. The changes going on between the tissues and the blood are only possible through the agency of lymph substance. It is fully as important in maintaining the nutrition of the tissues as the blood itself. There is a tendency, it is apprehended, to overlook the commanding importance of the lymph-flow of the body and to think only of the blood as the chief source of its nutrient supply. The tissues live upon this complex lymph fluid with which they are at all times saturated and from which, as has been said, they derive their sustenance.

While there is uniformity of function in the exchange between blood and tissue — the blood giving oxygen to the tissue and receiving carbonic acid from it in return — the ratio of such interchange is not uniform or constant. If it were, it is difficult to imagine how there could ever be a diseased organ in the body. It is rather because these interchanges may and do take place at different ratios, at times, that

physical equilibrium becomes disturbed and disease ensues.

The color of the blood is given to it by the red corpuscles, which are estimated roughly at about five millions to a cubic millimeter. These corpuscles are the carriers of oxygen from the lungs to the various tissues of the body. Physiologists believe this is due to the power of the hæmoglobin in the corpuscle to attract the oxygen to it from the atmosphere.

The blood also contains white corpuscles concerning the precise functions of which physiologists can scarcely be said to be even yet fully agreed. It is known, however, that they exist normally in the proportion of about one white to three hundred or more of the red. Foster claims that while the red corpuscles are limited to carrying oxygen from the lungs to the tissues, the white corpuscles are of still greater importance to the blood, inasmuch as they exert more influence on the plasma itself and assist in maintaining it in proper condition. The white corpuscles possess the power to pass through the walls of the capillaries and minute veins. They thus pass from the blood into the lymph spaces of the tissues lying outside of the blood vessels. This characteristic of the white corpuscles has given rise to the phrase current in medical literature, viz., "migration of the

white blood corpuscles" — a condition which distinguishes, and is always present in inflammation.

The quality of the blood is determined largely by its corpuscular elements. Among the laity, much is heard about "poor blood," "thin blood," and similar inexact phrases or unintelligent talk which, it is feared, the profession as a whole, has not been inclined to take the trouble to correct. The idea that is sought to be conveyed by these inexact phrases is that the normal quality of the blood has, in some manner, suffered deterioration. As understood by physicians, it refers, of course, to a deficiency in the blood of the requisite number of red corpuscles, and because of that, the intake into the body of oxygen is diminished, for nothing is better settled than the proposition that the red corpuscles absorb oxygen in their passage through the lungs. Once every twenty-four seconds, it is estimated, the entire volume of blood in the body passes through the lungs for the purpose of exchanging carbonic acid for oxygen and returning the latter to the various tissues which it traverses. But it is, perhaps, not so clearly and generally recognized that the quality of the blood is deteriorated *by the absence of the normal number of the white*

corpuscles. Metchnikoff was the first to direct particular attention to the important part played by the white corpuscles in maintaining health and in overcoming disease. The solution of exudates or other products of inflammatory processes, is believed to be accomplished solely through the action of the white corpuscles in disintegrating them so that they become detached and are carried off into the veins and lymph channels. It is obvious, therefore, that an increased flow of blood is of the first importance to a part occluded by exudates. Occluded blood and lymph channels may be reopened and thus forced into function again and their nutrition as well as that of contiguous parts, restored by increased blood pressure.

The white corpuscles also serve another highly important purpose. They are for this purpose, recognized under the name of *phagocytes.* It is through what is known as the process of *phagocytosis* that the body is protected from the ravages of microbes. The phagocytes act not only as sentinels protecting the organism against the invasion of destructive germs, but also as executioners, inasmuch as they set upon and destroy microbes after they have succeeded in effecting an entrance into the body. It is alone through the efficient action of these

phagocyte cells that the body is preserved from destruction or domination by the vast army of microbic foes which is continually seeking entrance to it from without. The process of taking into our bodies all forms and characters of germs is constant — an operation covering every minute of our physical existence. So long as the phagocytes, however, are able to efficiently perform their appointed mission, we are unconscious of the invasion that is constantly going on. When, however, the phagocytes fail, through any cause, to adequately discharge their duties, the body straightway becomes the helpless prey to microbic infection of various kinds. Obviously, then, the maintenance of unimpaired physical functions requires that the white no less than the red corpuscles shall be present in the blood in normal quantities.

Where are the corpuscles when they are not in the blood current? Quincke found by a series of experiments, that when the circulation became sluggish or inactive, presumably because of deficient neural impulse, the corpuscles accumulated in the capillaries of the liver, spleen and other vascular viscera, and that if long detained there, they underwent a process of disintegration. This view is supported by the disclosures made by the aid of the micro-

scope in examinations of the blood in cases of anæmia, and especially in leucocythemia, where the difficulty is not so much from deficiency of production as from *excessive destruction, of the corpuscles.* Not so many years ago, it was held by good authority, that the principal function of the spleen was that of a cemetery for useless and inert blood corpuscles. The more modern, and it would seem, the correct view, is to totally discredit that theory. To accept the theory formerly held, would be equivalent to believing that the spleen had, through some trick of Nature, been perverted to an abnormal purpose and exercised a malign effect upon the body instead of performing a physiological function. The large accumulation of corpuscles in either the liver or the spleen, injuriously affects those organs, while at the same time the blood is thereby deprived of its most necessary element for maintaining intact the tone and life of the various tissues of the body.

The practical inquiry that is suggested by this brief consideration, turns upon the possibility of preventing the accumulation of these blood cells in parts where they are not needed, and also as to how they may be restored to the circulation after this undesirable event has actually occurred. Inasmuch as this accumu-

lation has been found only when the blood current is slow or inactive, and when, on the other hand, the pressure has been increased, they leave the capillaries of the vascular viscera and reënter the main blood currents, the indications for attempted treatment at once become obvious. Blood pressure must, in some way, be raised. The circulation must be stimulated to greater activity. Discussion as to the method by which this can be the most effectively accomplished, will be deferred to a later chapter, when the vaso-motor areas of the spinal column are considered.

Were it not for the friction or resistance in the minute arteries and capillaries to the progress of the blood current, there would be very much less use for a heart than now exists. Because of the resistance of the capillaries to the flow of blood into the small veins, the force of the heart's beat is expended in maintaining the entire arterial system in a state of great distension. But, as has already been seen, the heart is not exclusively concerned in carrying on the circulation of the blood. It is well known that the pressure in the vessels (aided, it may be, by the amœboid movement and ciliary motion (?) of their component cells) would be sufficient to propel the blood current in the absence of marked interposed resist-

ance. But because of the resistance, as above stated, of the capillaries, the propelling force of the heart becomes necessary. The blood vessels themselves — the arteries and veins — by reason of their connection with the nervous system, possess the power of modifying to a large extent, the distribution of the circulation regardless of the heart. The action of what is known as the "vaso-motor" system is a very large and important factor in the circulation. The general tone of the blood vessels is largely if not absolutely, controlled by the vaso-motor nerves which govern the entire blood flow in the body. Normal pressure or flow of blood is largely dependent on the "general tone" of the minute arteries.

Foster, in his Physiology (page 219), says: "Most if not all the arteries of the body are supplied with vaso-motor fibres running in this or that nerve, the fibre being either vaso-constrictor or vaso-dilator, and some nerves containing one kind of fibres only, some both, in varying proportion. Almost every nerve in the body, therefore, may be looked upon as influencing a certain set of blood vessels, or governing a vascular area, the area being large or small, and the 'government being exclusively constrictor or exclusively dilator, or mixed.'"

When a muscle contracts, there is always an

increased flow of blood through it. In the case of muscular contractures, where some of the fibres are inhibited so that rhythmic contraction no longer takes place and the muscle remains a hard, unyielding, uncontracting mass, it is obvious that the circulation to the adjacent tissues must be greatly compromised and abridged. It is not within the jurisdiction of the heart, believed by so many to be the dominating factor in the circulatory system, to either change or modify this local condition. The heart may continue to steadily pump away at normal or even at abnormal pitch; nevertheless, tissue in close connection with and dominated by, a contracted muscle, may be steadily perishing for lack of the life-giving stream in sufficient quantities to maintain local nutrition.

The practical side of this consideration and to which, it is hoped, this hasty and necessarily somewhat superficial review of the physiology of the blood and its circulation has naturally led, is as to what it is possible to do by mechanical-vibratory treatment towards overcoming resistance to blood pressure, and *how* it is to be accomplished? If tissue (and by that is also meant an organ or viscus) is being starved because enough of the life-giving fluid does not reach it on account of an obstruction

induced by a chronically contracted muscle, the cause must, first of all, of course, be removed. In no way can that result be so readily and quickly accomplished as by the aid of mechanical stimulation applied deeply over the site of the contracted muscle. The changes thereby effected are frequently startling and rapid. Under such treatment, the contraction quickly subsides, and the muscle becomes soft where before it was tense and knotted. One treatment does not, however, usually suffice to maintain permanent relaxation of a muscle that has been contracted for any considerable length of time. It needs to be repeated every day or every other day, for a varying period of ten days to three weeks, in order to secure permanent relaxation of the contracture.

Respecting the effect of mechanical-vibratory stimulation upon the vaso-dilator and constrictor nerves, all that is essential may be quickly said. But briefly as it may be said, it is of commanding importance, nevertheless, inasmuch as it means our ability or inability, by extra stimulation, to save tissue or an organ from disease through de-nutrition. If the organ can be fed — if more blood can be directed to that particular part — it may regain its impaired functions and become normal; otherwise, such abnormal

changes may take place in it as to seriously endanger the integrity of the entire organism.

The practitioner having decided what tissue or organ is affected (which is disclosed by the irritation at the centre in the spine from which the affected organ receives its nerve supply), should consult the chart, which is the frontispiece of this book, and determine the vaso-motor area in the spinal column which controls the circulation to the affected area or organ, and then apply stimulation to the nerve area thus indicated.

Concern need not be felt respecting the exact neural branch to be so affected — whether a vaso-constrictor or a vaso-dilator nerve in a given case. It will be entirely safe and wise to apply the stimulation to the vaso-motor area and trust to nature, who understands her business so much better than we do, to determine which quality in a nerve or which group of its fibres, shall respond to it. It will be entirely safe to do this for another practical reason. *Irritated nerve fibres,* as is pretty well known, *respond more quickly to stimulation than unaffected nerve fibres!*

One of the great advantages that may be legitimately claimed for treatment by mechanical stimulation, is that it is preëminently a

natural method. In its application to diseased organs, we do not antagonize nature nor interfere in the elaboration of physiological processes; on the contrary, her efforts are supplemented and complemented. After art has exhausted its resources in attempts at cure, do we not know that it is nature that becomes at last the real, the supreme healer? It is to be apprehended that amid the contentions of the various schools of medicine in their struggle for supremacy and popularity, this generally accepted fact has been largely lost sight of, or its importance minimized. That system is likely to be most efficacious that aims to assist but does not attempt to supersede, the natural method of cure. Physicians of all schools and creeds recognize the natural tendency of every form of disease toward spontaneous cure, and they also realize probably how little of the credit for many of the recoveries that happily occur, is due to them (undeniably true in many cases of acute disease), and how vastly much more rightfully belongs to the operation of the recuperative agencies of nature.

It is chiefly when and where these inherent recuperative forces become, through any cause, inhibited for the time being from evolving a cure, that artificial assistance is actually required and should be employed.

The most powerful locomotive, capable of drawing smoothly thousands of tons over an unobstructed track may, at times, be stopped or even wrecked by an obstruction in its path weighing not more than a few hundred pounds, but which it is powerless, for the moment, to overcome or remove. In some such analogous way, it is believed that nature carries on the vital processes of the human body, evolving a cure by the same biological law of evolution that produced the disease. To affirm that it successfully accomplishes this an hundred times to every single failure, is only paying a fair tribute to the magnificent capabilities of that omnipresent power and life in which we do most truly "live, move and have our being."

We cannot successfully usurp by the artificial agencies at our command, natural functions or processes of repair, but may, at times, facilitate and assist them by removing obstacles from the pathway to cure. By stimulating here and there a flagging organ or inactive function, we may put the organism in such condition as to render *restitutio ad integrum* possible where otherwise it would be impossible. The physician who succeeds in doing this, may very properly feel that he has achieved no small or mean success. Indeed, it is here where he is likely to score his high-

est triumph and to best conserve his profession and his own reputation.

In concluding this chapter, treatment by mechanical stimulation is recommended as an agent of singular efficiency in stimulating a larger blood-flow to parts of the body that may be deteriorating because of a deficiency of it. Its application, in this regard, is along the line of natural processes, and there is no recognized method at the present time that will so promptly and efficiently direct and control blood distribution with all its consequent train of changing benefits.

CHAPTER IV

THE LYMPHATIC SYSTEM

THERE is no part of the body that is of greater importance in the maintenance of health than the lymphatic system. Perhaps, also, there is no part that is so little understood in its relationship to the general health or the importance of which is so greatly under-estimated. Certainly the older physiologies do not even give a lucid, much less an *adequate* idea, of the important part which the lymphatic system plays in the functionation process of the human body.

The statement so generally made that the blood leaves the heart by the arteries and returns through the veins, is only partially true, inasmuch as in the capillaries some of the blood plasma finds its way into the cells of the tissues and nourishes its elements. The lymph fluid is collected and conveyed back into the blood by a system of vessels called *lymphatics*. They commence in a series of lymph capillaries in the organs and tissues of the body and terminate in two large trunks which open into the larger veins near the heart — the *thoracic duct* on the left, and the *right lymphatic trunk* on the right. (See Plate II.) The lymph

Plate II.

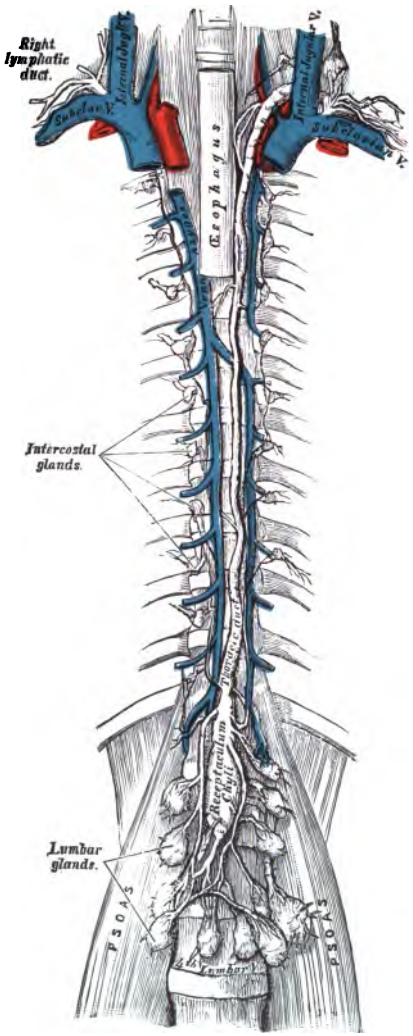

Diagram showing the deeper lymphatics of the body.

(The deeper lymphatics are best reached by placing patient on back, knees well elevated, and applying deep vibratory pressure on each side of the abdomen just below the umbilicus, using for this purpose, attachment No. 1. as shown in Plate VIII.)

which they contain, unlike the blood, passes in only one direction — from the smaller branches to the trunk and thence into the large veins where it loses its identity as a distinct fluid and becomes part of the constituents of the blood.

The lymph capillaries commence in closely meshed network and also in irregular lacunar spaces between the various structures of which the different organs are composed. They are also found in closed cavities or sacs, such as serous membranes, etc. All parts of the body, beginning with the head and neck, are plentifully supplied with lymphatic vessels commonly known as *the lymphatics*. All the lymphatics pass at some point of their course, through what are known as lymphatic glands, which are believed to be the points of origin of the *lymphocyte,* — a sort of colorless corpuscle. Foster and Ziegler contend that these glands have valves, very similar to those of the veins, which serve to give impetus to the flow of the lymph. The lymphocytes pass into the blood with the lymph and there become converted into *leucocytes* which, as has already been seen, perform very important functions within the organism. The lymphatic glands are numerous along the great vessels of the abdomen, thorax, neck, in the mesentery, in the axilla, and in the groin. They are also found in the

popliteal space, and in the arm as far down as the elbow. These glands, in addition to being the factories of the lymphocytes and temporary reservoirs for lymph, also drain the tissues adjacent to them, and are, consequently, important factors in the process of absorption.

Lymph comes into more intimate relationship with tissue metabolism than even the blood, conveying nutriment to them and receiving from them in return, the products of their activity. Lymphatic glands are, as has been already intimated, both secretory (producing the lymphocytes) and excretory (draining the waste and deleterious material from contiguous tissue and discharging them into the circulation), and perform these dual functions simultaneously. They are especially liable to become overloaded with waste or deleterious matter, which partially inhibits their function. In such condition, unless stimulated to renewed activity, auto-intoxication is set up within the body. These glands, somewhat sluggish in their natural action, are, nevertheless, highly responsive to stimulation, and their excretory functions may be materially enhanced thereby. Probably no other part of the body is more amenable to what may be called the "coaxing process" than the lymphatics, particularly the lymphatic glands. Their natural tor-

Plate III.

Diagram showing the lymphatics of the neck and axilla.

(To insure increased drainage of the neck, arm and upper part of the thorax, the axillary group shown in diagram should be stimulated.)

por doubtless arises from the toxic effect of the waste and poisonous matter that drains into them from the surrounding tissues, and for which they act more or less as reservoirs.

Kirke, in his Hand-book of Physiology (page 316), in speaking of the lymph-flow says, "The flow of the lymph toward the point of its discharge into the veins, is brought about by several agencies. With the help of the valvular mechanism, all occasional pressure on the exterior of the lymphatic and lacteal vessels propels the lymph onwards; thus muscular and *other external* pressure accelerates the flow of the lymph as it does that of the blood in the veins."

From this cursory review of the structure and function of the lymphatic system, it must be readily seen that it is of commanding importance in the physical organism. The whole problem of the elimination of the product of metabolism as well as the metabolic process itself, is dependent upon the efficient functionation of this system. Of what avail would be normal activity of liver, kidneys, spleen, intestines — the entire group of eliminative organs — if the tract over which poisonous products must pass in their exit from the tissues to the various emunctories were obstructed and their transit interfered with?

Auto-intoxication and infection must, in such cases, inevitably result.

In the successful treatment of every form of local inflammation, glandular enlargement, varicosities, tumors, and the like, the detritus or broken-down product must not only be removed from the tissues to the lymphatics, but they in turn must discharge the mass into the circulation *en route* to the point of elimination. Obviously in cases of unusual demand upon these glands, their action must be stimulated, for it is to be remembered that these very products lower the natural activities of the glands, by reason of the partial local toxæmia they induce.

Any treatment that breaks down a mass of diseased or infectious tissue and allows it to be thrown upon the lymphatics without providing for their stimulation so as to ensure rapid absorption, is founded on a false basis and is bound to result disastrously to the patient. It is precisely at this point that the weakness in the present somewhat popular treatment of cancer by means of the X-ray, becomes apparent. Unless extreme care is exercised in the exposure of the cancer-infected area to the action of the X-rays, serious injury is liable to result to the surrounding lymphatics. This unfortunate condition has been observed in quite a large number of cases so treated. The

PLATE IV.

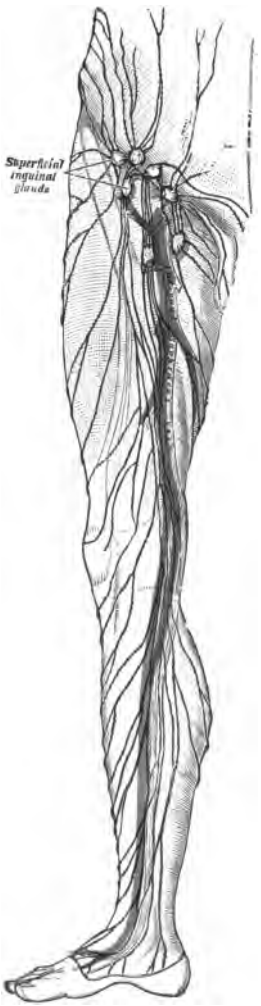

Diagram showing superficial lymphatics of the leg and groin.

(Increased drainage is secured through stimulation applied to the glands, as shown in above diagram.)

contiguous lymphatics which must be depended upon to drain the affected area, were found atrophied and the remaining parts more or less indurated. In either case, their usefulness was greatly abridged and, in some instances, positively inhibited. Even when the shield is employed and every precaution is taken to limit the action of the ray within the circumscribed affected area, it is not by any means certain that its pernicious effect upon the adjacent healthy lymphatics is or can be, wholly obviated. But conceding that this danger — and it is a most serious one — is successfully averted, still, large masses of cancerous tissue are disintegrated and carried into the lymphatics, already more or less dormant, and there set up a modified or local infection which at last partially inhibits their activity. Auto-infection, which is the logical corollary of such action, quickly supervenes and the patient while being cured of the cancer, perishes from absorption of septic matter. If the lymphatics are susceptible of performing their functions only under normal demands, is it not manifest that they must be assisted in meeting any unusual or abnormal draft that may be made upon them? What utility is there in breaking down a mass of poisonous matter without providing, at the same time, means for its prompt

elimination? It can, at best, only accelerate the inevitable termination without in any wise increasing the patient's chance of recovery.

Treatment by mechanical stimulation, however, meets the demand for enhanced absorption of waste product with directness and great efficiency. With the rubber brush attachments deeply pressed over the glands, there is thus supplied "the external pressure" declared by Dr. Kirke (quoted above) to be the proper method for accelerating the flow through these organs. It is useless to attempt the cure of local inflammations, or the resolution of adventitious growths, without at the same time providing for prompt and adequate drainage and the discharge of the detritus through stimulation of the lymphatics. Efficient as mechanical-vibratory stimulation unquestionably is in all such forms of disease, even with it satisfactory results are absolutely out of the question unless treatment is also applied to the contiguous lymphatics and glands. If the lives of cancer-affected patients are to be saved, at the same time that the local manifestations of the disease are being destroyed, it can only be accomplished through energizing the natural action of these important organs. The lymphatics are not organs that can be

Plate V.

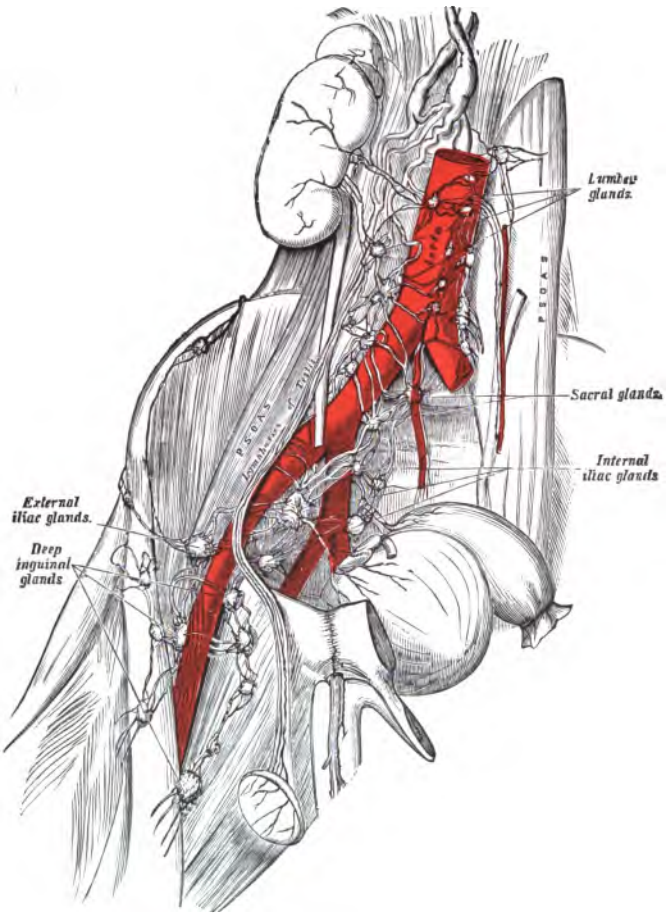

Diagram showing the lymphatics which drain the kidneys and pelvic organs.

(Drainage through the kidneys and pelvic organs is increased by the application of mechanical vibratory stimulation to the lymphatics of these areas, as shown in above diagram.)

ization. As a matter of fact, the writer does not believe that surgical interference with a malignant growth has very often been the *immediate* provocative factor in its recurrence at some other point. On the contrary, it appears more probable that the surgical procedure in breaking up the local habitat of the cancer, scattered its cells, and the contiguous lymphatics being inactive or unable to receive and pass them into the venous current *en route* to the excretory organs, they were poured into the venous circulation *direct* and deposited in some of the tissues along its course. The lymphatics, as has been already seen, may have become partially inhibited in consequence of the poison thrown upon them, and thus rendered incapable of elaborating the process of normal absorption; or, they may have become disabled through the traumatism of the surgical operation itself. In either event, to their inaction, there is strong warrant for believing, is due the re-localization of the disease in some other organ in post-operative cases.

Strong support is found for the contentions of this chapter that the lymph glands are prone to become "comatized," so to speak, from the poisonous products thrown upon them and so lose the power to help them-

selves, in the condition they present in the course of general infection by syphilis, scrofula and, frequently, tuberculosis. In such conditions, these glands are generally indurated and enlarged, and the more markedly they are involved, the more profound is the general systemic infection. Notwithstanding this patent fact, which all physicians must have recognized, the importance of maintaining the tone of the lymphatic system has never appealed as strongly to the profession as the gravity of the functions performed by it would seem to demand.

As was intimated earlier in this chapter, much confusion has prevailed as to the precise function of the lymphatic system. In the chapter on the circulation, reference was made to the characteristics of the phagocytes and leucocytes and to the important duties which they are believed to perform. It is in the lymph channels and glands that the process of phagocytosis is supposed by many eminent pathologists to take place. It is here the destructive germ or poisonous substance is seized upon by the phagocyte, torn apart, digested, and the detritus, robbed of its infecting quality, is discharged into the blood current to be finally eliminated by the excretory organs. Is it not apparent that if

this physiological process is to be successfully carried on, the lymphatics must be fully equal to the demands made upon them? Indeed, is it too much to affirm that the lymphatic system for the purposes we are now considering, is the pivotal factor in the problem? Upon its action, in almost any event, depends the weal or woe of the physical organism.

It will thus be seen how commandingly important, when treating any form of localized disease, whether benign or malignant, it is that stimulation should be applied to the lymphatics. The treatment of goître by mechanical vibration has been highly successful, but only when it included stimulation of the lymphatics, especially those of the axilla. It can be stated positively that the results in goître treatment were never satisfactory when this important part was omitted. Nature has made provision for carrying on the physiological functions of the body and against great odds. Nowhere is this fact more markedly exemplified than in the study of the lymphatic system. As was stated in the previous chapter, the physician's mission is to assist Nature to regain her equilibrium when she falters. In theory it is quite simple, but in its practical application it may become a problem fraught with the deepest complexity.

CHAPTER V

RESPIRATION

BECAUSE of its influence upon the circulation and the various tissues of the body, it has seemed desirable to discuss very briefly some of the features of respiration, and to indicate how this function may be favorably affected by mechanical-vibratory treatment.

Attention is first invited to *the mechanism of respiration* as it takes place in the thorax or the lungs. While recognizing the fact that the larger amount of oxygen entering the body is through the lungs, there is danger, perhaps, lest we minimize the importance of *tissue respiration.* Concerned in the subject of tissue respiration, is the highly important factor of tissue metabolism and its bearing upon the general well-being of the body. This will, however, be subsequently considered more at length in a chapter on *Muscular Metabolism.*

Respiration, as it takes place in the lungs, is controlled by two movements — *inspiration* and *expiration.* The mechanism of inspiration by which the chest alternately enlarges

and collapses, is carried on by two means, — the action of the muscular diaphragm and the elevation of the ribs. It may be said, therefore, that the mechanical part of thoracic respiration is dependent upon muscular effort inasmuch as the elevation of the ribs is controlled by the intercostal muscles. The descent of the diaphragm is effected by means of the contraction of its muscular fibres. In descending, the diaphragm presses on the abdominal viscera. From its attachments to the sternum and false ribs, the diaphragm, in contracting, naturally tends to draw the sternum and upper ribs downward and inward, and the lower false ribs upward and inward toward the lumbar region and the spine. Foster says that in normal breathing this tendency produces little effect because it is counteracted by the accompanying general costal elevation. But, in forced expiration, on the other hand, where there is any obstruction to the entrance of air into the lungs, the lower ribs may be so much drawn in by contraction of the diaphragm that the girth of the trunk at this point is obviously diminished.

The part played in the process of inspiration by the elevation of the ribs is even more complex than the descent of the diaphragm.

Perhaps no more brief and at the same time comprehensive statement of the mechanism of inspiration has ever been made than that by Foster. He says: "If we examine any one rib, such as the fifth, we find that, while it moves freely on its vertical articulation, it inclines, when in the position of rest, in an oblique direction from the spine to the sternum; hence it is obvious that, when the rib is raised, its sternal attachment must not only be carried upward, but also thrown forward." The rib may in fact be regarded as a radius, moving the vertebral articulation as a centre, and causing the sternal attachment to describe an arc of a circle in the vertical plane of the body. As the rib is carried upward from an oblique to a more horizontal position, the sternal attachment must of necessity be carried further away in front of the spine. Since all the ribs have a downward slanting direction, they must all tend, when raised toward the horizontal position, to thrust the sternum forward, some more than others, according to their slope and length. The elasticity of the sternum and costal cartilages, assisted by the articulation of the sternum to the clavicle above, permits the front surface of the chest to be thus thrust forward as well as upward,

when the ribs are raised. By this action, the antero-posterior diameter of the chest is enlarged. Since the ribs form arches which increase in their sweep as one proceeds from the first downward, as far at least as the seventh, it is evident that when a lower rib, such as the fifth, is elevated so as to occupy or to approach toward the position of the one above it, the chest at that level will become wider from side to side, in proportion as the fifth arch is wider than the seventh. Thus the elevation of the rib increases not only the antero-posterior, but also the transverse, diameter of the chest. Further, on account of the resistance of the sternum, the angles between the ribs and their cartilages are, in the elevation of the ribs, somewhat opened out and thus also the transverse as well as the antero-posterior, diameter somewhat increased. In more than one way, then, the elevation of the ribs enlarges the dimensions of the chest.

The ribs are raised by the contraction of certain muscles. Of these, the *external intercostals* are perhaps the most important. Even in the case where two ribs, such as the fifth and sixth, are isolated from the rest of the thoracic cage by section of the structures occupying the intercostal spaces above and be-

low, the contraction of the external intercostal muscles of the intervening space raises the two ribs, thus bringing them toward the position in which the fibres of the muscles have the shortest length, viz., the horizontal one. This elevating action is, in the entire chest, further favored by the fact that the first rib is less movable than the second, and so affords a comparatively fixed base for the action of the muscle between the two; the second in turn supporting the third, and so on, while the *scaleni muscles,* in addition, serve to render fixed or to raise, the first two ribs. So that in normal respiration, the act may probably be described as beginning by a contraction of the scaleni. The first two ribs being thus raised, or at least fixed, the contraction of the series of external intercostal muscles acts at a great disadvantage.

Thus it will be seen that the process of inspiration is a somewhat complex one. Expiration, on the other hand, is comparatively simple. In normal breathing, it is a simple effect of elastic reaction. In the effort of inspiration, the elastic tissue of the lungs is put on the stretch, and while the muscles concerned in inspiration continue their contractions, the tissues remain stretched. When, however, these muscles relax, the elasticity

of the lungs is reasserted and drives out a portion of the air contained in them. It is the same with the sternum and costal cartilages. Expiration, then, is elastic reaction, and the process is accomplished without the expenditure of much, if any, muscular energy.

Owing to the attachment of the pectoral muscles to the ribs as low as the seventh, and also to the humerus, it will readily be seen that raising the arm facilitates the elevation of the ribs and thereby favors greater expansion of the chest. This should always be borne in mind and the arms raised, when mechanical stimulation is being applied for its effect on the lungs.

The mechanism of thoracic respiration assumes especial importance when considering the claims of treatment by mechanical stimulation. Respiration itself is a function of great importance, of course, because on its efficient action depends not only the well-being of every organ and tissue of the body, but also the continuance of its existence. Through it the body receives the life-giving oxygen and throws off the deadly carbonic acid, and probably other deleterious products. When the action of the respiratory apparatus falls below normal, it is obvious that not alone the lungs but every part of the entire body, must suffer.

If breathing were not so much a matter of muscular effort, it would doubtless be more properly performed. Unfortunately it requires the output of energy to breathe properly, which many are unwilling, in their ignorance of its importance, to exert. But here, as elsewhere, nature has made provisions by which some small part at least of the function of respiration may be discharged through the tissues. It is a debatable question as to the length of time that life could be preserved were it dependent solely upon the intake and output of oxygen and carbonic acid through the tissues. Nevertheless, it is well known that life cannot long be maintained without the assistance of tissue respiration. As has been already seen, respiration is a muscular process of a highly complicated character. Its perfect accomplishment depends upon the correct and normal action of the muscles concerned in and controlling it. These in turn are influenced and controlled by their nerve supply. Foster says:* "Normal breathing may continue not only in the absence of consciousness, but even after the removal of all the parts above the medulla oblongata. * * * It is impossible that all these so carefully

* Nervous Mechanism and Respiration, p. 369.—Text-Book of Physiology.

coördinated contractions should be brought about in any other way than by coördinate nervous impulses descending along efferent nerves from a coördinating centre. By experiment we find this to be the case. * * * And when an intercostal nerve is cut, no active respiratory movements are seen in the intercostal muscles of the corresponding space, and when the spinal cord is *divided below the origin of the seventh cervical spinal nerve,* that is, below the exits of the roots of the phrenic nerves, costal respiration ceases. When the cord is divided below the medulla, all thoracic movements cease, but the respiratory action of the nostrils and glottis still continues."

There is thus reason for thinking that the respiratory motor nerves, like other motor nerves, are connected just as they are about to issue from the spinal cord, with a nervous machinery in which nerve-cells play no inconsiderable part. There is also reason to think that the respiratory impulses pass into and are modified by a secondary spinal nervous mechanism before they issue along the motor nerve roots.

The importance of respiration in its *local effects* upon the body, aside from the lungs, has not received the careful consideration

which its great importance demands. Whether if it were more perfectly performed, and the entire lung capacity utilized (as it is well known is not done usually by those who are only in the pre-tubercular pulmonary state), there would be more recoveries from the first or second stages of phthisis, is a question worthy of very serious investigation. Better breathing, it should be remembered, means more nutritive force (oxygen) for the whole body and less depression from retention of waste matter.

But the points it is especially desired to emphasize before concluding this chapter are, *first,* that the muscular energy concerned in respiration is *controlled and directed by nerve stimuli; second,* the fact of the existence of a nervous centre of respiration which can be reached and acted upon through the spinal cord. (See Foster's Text-Book of Physiology.)

With these two facts in mind — and they are well established facts in physiology — the reader should have no difficulty in realizing the commanding importance of the stimuli which mechanical vibration is capable of supplying, or the advisability of applying it to the centres controlling respiratory action in all conditions where the *general nutrition*

requires improvement. The connection between improved respiratory action and invigorated blood pressure is, as has already been seen, very close and intimate and is so readily apparent as not to seem to justify further elaboration in this connection. It would seem also to be equally apparent that treatment by mechanical stimulation in its localized application to the nerve centres concerned in the mechanism of respiration, is susceptible of accomplishing simultaneously several very desirable results quite aside from its effect upon the particular function which is the subject of this chapter.

Attention is again invited to the frontispiece diagram which shows the respiratory-centre area in the spinal cord, and which will more clearly indicate the points at which treatment, for its respiratory effect, should be applied.

CHAPTER VI

DIGESTION

THE organs composing the alimentary canal are the mouth, pharynx, œsophagus, stomach, and the small and large intestines. Concerned in the process of digestion, which commences in the mouth and is completed in the intestines (duodenum), are numerous glands opening at various points, into the alimentary canal. These glands pour their special secretions or juices into the general canal and so assist in the digestive process. Some of the digestive glands are situated in the mucous membrane of the canal, while others are located at some distance from it, which they reach with their secretions by means of tubes or ducts. The gastric and intestinal glands are of the former class, while the salivary glands, liver and pancreas, belong to the latter class.

The conversion of food into soluble substances is carried on in the alimentary canal and constitutes the process known as *digestion.* The entrance of this soluble matter into the lymph and blood vessels of the canal, constitutes the process known as *absorption.*

Digestion is both a mechanical and chemical process. Mastication, deglutition and peristalsis belong to the first named process, while the action of the various juices upon the food, produces the chemical changes necessary before absorption can take place.

In the process of digestion, the secretion of gastric juice in the stomach is, perhaps, of primary importance. This juice is a solution of a proteolytic ferment called *pepsin,* which contains also a small quantity of free hydrochloric acid. Foster estimates that in man the normal amount of free hydrochloric acid in healthy gastric juice, is about 0.2 per cent. Any disturbance in the relative proportion of the acid in the juice produces imperfect digestion and a consequent train of physical vagaries, the full description of which might easily fill a volume of much larger size than this book.

The gastric juice, important as it is, has only a limited action, however, upon the food that enters the stomach. It converts the *proteids* into soluble, diffusible *peptones.* These peptones are readily absorbed without further elaboration. Neither starch nor fats are affected by the gastric secretions. Cane sugar is inverted by the action of the acid contained in the gastric juice. Two of the largest food

elements — starch and fat — pass through the stomach practically unaltered and, as will presently be seen, are broken up and digested in the intestines.

The gastric juice, by reason of the acid it contains, is strongly antiseptic. Putrefactive processes do not normally occur in the stomach. Organisms that produce such processes and which may be swallowed with the food are, under normal conditions, destroyed and the body thus protected from their otherwise destructive action.

Other important features in the process of digestion, are the movements of the stomach. During the digestive act, the muscular fibres of the stomach are in a state of rhythmic contraction. This peristaltic action compresses the ingested mass of food, chymifies and propels it forward through the pylorus into the duodenum. While the stomach participates in the digestive act only to a limited extent, the *quality* of its action is such as to throw into utter confusion the entire process when it fails to actively perform its allotted part.

The peristaltic action of the stomach having propelled the undigested portions of the food (of which starch and fat are the larger part) into the duodenum, the digestive process is there resumed. The secretion of the pancreas

(pancreatic juice) is poured into the intestines and the liver discharges bile into it via the gall bladder. Bile alone has been demonstrated to possess very little digestive action, but acts energetically, especially upon fats, when combined with the pancreatic juice. Another secretion that has its centre of activity in the intestines, is *succus entericus,* which converts starch into sugar.

Considerable difference of opinion exists among physiologists as to whether or not bile is an antiseptic of much power. Some of the French authorities hold that it is very powerfully antiseptic and that putrefactive changes cannot take place in the intestine so long as the normal secretion and excretion of bile is maintained. La Follette claims that ulcerations of Pyers' Patches and the solitary glands never take place when the normal quantity and quality of bile is secreted and discharged. Louizeaux asserts that in 50 cases of typhoid fever examined by him, he found the bile-producing function of the liver had been acting inefficiently prior to the inauguration of the fever and so continued throughout its course.

Fats undergo a twofold change in the intestines. One is a physical change (emulsification) and the other is a chemical change

(saponification). They are finally absorbed by the lacteals, which are part of the intestinal lymphatic system. Absorption also takes place through the columnar epithelium cells.

Having thus hastily glanced at the principal features in the digestive process, the next inquiry and the one of the greatest practical importance in connection with the subject of treatment by mechanical stimulation, is as to the part played by the nerves in governing the digestive function.

Salivary Glands

Kirke holds that the nerves which control and regulate the secretion of saliva, are derived from the cranial and sympathetic nerves and ramify between the gland cells. When, therefore, stimulation of the salivary function is desired, treatment should be applied directly over the salivary glands.

Gastric Glands

The vagi contain the secretory fibres controlling the *secretion of gastric juice.* The muscular or peristaltic action of the stomach is controlled through the solar plexus and the nerves given off from the 4th to the 7th dorsal. In conditions of hyperacidity of the stomach, due to an excess of hydrochloric acid

in the gastric juice, relief can almost certainly be expected from the application of vibration to the muscles at the angle of the ribs extending from the 6th to the 10th dorsal *on the left side.* Great sensitiveness to pressure over these muscles, will usually be found in all conditions of hyperacidity, and may be taken ordinarily as an indication of the real trouble operative in the stomach when, as sometimes occurs, the caustive factor is masked under a set of vagarious symptoms.

Pancreas

The vagi contain the secretory nerves supplying the pancreas and which control the secretion of the pancreatic fluid. Stimulation should, therefore, be applied over these nerves at the sides of the neck.

Bile (Liver Cells)

The secretion of bile is largely controlled through the 3d to 11th dorsal nerves inclusive. The constrictors of the liver are contained in the splanchnic; the dilators are in both the splanchnic and vagus.

Stimulation also of the 9th and 10th dorsal nerves contracts the gall bladder and the *ductus choledochus communis,* while inhibition (deep pressure) of the same nerves, causes relaxation in those organs.

Intestines

The small intestines are connected with the central nervous system by the vagi and the splanchnic nerves. The vagi exercise a powerful influence over intestinal peristalsis. Mild stimulation of these nerves induces increased peristalsis; strong stimulation retards peristaltic action, and if the pressure is sufficiently heavy and prolonged, arrests it completely. For this reason, moderately deep pressure, continued from one to three minutes, over the vagi is followed by excellent results in various forms of intestinal irritation, of which diarrhoea is a conspicuous example.

Information more in detail relative to the connections between nerve centres and the viscera, may be had by reference to page 325, of Kirke's Handbook of Physiology, under the title of "Influences of the Nervous System upon the Spleen"; and to pages 510 and 511, relative to "Diabetes," and "The Nerves of the Liver," of the same work.

CHAPTER VII

SECRETION

It is the function of gland cells to produce by the metabolism of their protoplasm, certain substances called *secretions*. These materials are of two kinds, — those which are used for the purpose of assisting in carrying on the functions of the organism, and those which are discharged from the body as effete or injurious. The latter are known as *excretions*, concerning which more will be said in the succeeding chapter.

Secretions may be said to be substances which do not preëxist in the same form in the blood. They require special cells and a process of elaboration for their formation, as for example, the mammary-gland cells for the formation of milk, the liver-cells for the formation of bile; and the gastric cells for the formation of the gastric juice.

The principal secretory organs are:

(1) The serous and synovial membranes;

(2) The mucous membranes with their special glands, *e. g.*, the buccal, gastric and intestinal glands;

(3) The salivary glands and pancreas;

(4) The mammary glands;

(5) The liver;

(6) The lachrymal glands;
(7) The kidney and skin; and
(8) The testis.

Kirke believes (see page 164, Handbook of Physiology) in the existence of *secretory* nerves and that they supply many secretory glands, such as the salivary glands, pancreas, gastric and sweat glands. Presumably he also believes that by the stimulation of these secretory nerves, secretion in the various organs which they supply, may be increased. As a matter of demonstrated fact, this can be positively affirmed.

In the course of the treatment of disease, it frequently becomes of the greatest importance to secure increased secretion in an organ or organs. Those which experience has shown most frequently to require it, are:

(1) The stomach;
(2) The liver and spleen;
(3) The kidneys; and
(4) The intestines.

The Stomach

Stimulation of the gastric glands is accomplished through vibratory pressure over the vagi at the sides of the neck (see page 463, of Kirke). Experiments have established the fact that the vagi contain the secretory fibres for

the gastric glands. Fibres of the sympathetic, leave the cord at the 5th to the 8th dorsal.

The Liver

The vaso-motor nerve fibres control the secretion of bile and supply the portal vein. They leave the spinal cord at the 3d to the 11th dorsal inclusive. This is on the authority of Bayliss and Starling (see Kirke, page 512), but the individual practitioner using mechanical vibratory stimulation over this spinal area, will be able to quickly demonstrate the truth of this assertion and become his own authority thereafter on this subject.

The Kidneys

The nerves controlling the secretion of urine are derived from the renal plexus. Fibres from the anterior roots of the 11th and 12th dorsal and 1st lumbar nerves pass into this plexus, and to these stimulation should be applied. The nerves of this plexus are both vaso-constrictor and vaso-dilator in function, and perform the office of maintaining normal equilibrium in the secretion of urine.

The Intestines

The secretions of the large and small intestines for the purpose of lubrication, are controlled from the 1st to the 4th lumbar nerves.

The same spinal centre also governs contraction of the sphincter ani. Stimulation of the pneumogastric, through the solar plexus, excites peristalsis. Inhibition of excessive peristalsis may be accomplished through pressure applied over the nerves from the 6th dorsal to the 1st lumbar.

The Liver

Claude Bernard has shown that an increase of sugar in the blood is produced by stimulating the central and peripheral ends of the divided vagus. On section of both vagi, however, the sugar disappears from the blood and glycogen from the liver and tissues generally. These results, Bernard claims, are due to the direct influence of the nerves on the liver cells, which are largely concerned in the secretion of bile as well as in performing other functions.

Upon the authority of Bayliss and Starling (Kirke's Physiology, page 511) the vasoconstrictor fibres for the portal nerve, leave the spinal cord at the 3d to the 11th dorsal nerves inclusive. The nerves of the hepatic artery are constrictors contained in the splanchnic, and dilators in both splanchnic and vagus. The secretory nerves, therefore, may be stimulated in both areas — from the 3d to the 11th dorsal, and in the splanchnic region of the spine.

CHAPTER VIII

EXCRETION

HAVING seen in the previous chapter how largely the element of nerve stimulation is concerned in the process of secretion, attention is now invited to a brief consideration of the functions of *excretion* or elimination.

The relationship between secretion and excretion is very close. After the secretory organs have performed their duties and metabolism has taken place, the excretory process, under normal conditions, promptly begins. It is impossible to select out of the several primary physiological processes, such as circulation, respiration, secretion, and the like, a particular function and assign to it correctly, greater importance than to the others. The human body is a complex organism both in structure and function, and its healthy action can be maintained only through the synchronous and harmonious action of *all* its organs and processes. It would not be correct, therefore, to say that normal excretory action is of *first* importance. But it would be stating the case fairly to say that a state of bodily

health cannot long be maintained where the excretory process is inactive or inefficient. In such a condition, imperfect secretion, faulty metabolism, and a general derangement of function, are bound to occur. It is needless to add, perhaps, that in some such way all chronic disorders, involving changes of structure in the various organs, have their beginnings.

It may well be questioned whether in the natural rebound from over-stimulation and the drastic urging of excretory organs and functions, so much in vogue less than fifty years ago, the newer and better practice is not tending now too much towards the opposite extreme.

Continuance of life as well as of health, is dependent upon the efficient action of each of the several excretory functions. If the kidneys fail to separate the urine from the blood, uremic poisoning and coma ensue from retained urea. Failure of the liver to perform its normal functions, either as a secretory or expelling (excretory) organ, leads, in time, to practically the same result. The same is true of the faulty action of the intestines. After the metabolic process has been completed in the liver, the entire responsibility for the final elimination of the resulting excreta, is referred to the intestines.

The principal organs concerned in excretion and which are of special interest to the practitioner who intends to employ mechanical stimulation as a remedial agent, are the

Lungs, Skin, Liver, and the *Intestines.*

In the chapter on *Respiration,* the method of treating the lungs was indicated, and it is not desirable, therefore, to further refer to it here. So, also, in the preceding chapter on Secretion, the nerve connections and indications for the treatment of the liver, kidneys and intestines were outlined, to which the reader is referred, in connection with the frontispiece diagram showing the nerve centres controlling the various viscera, etc. The nerve centres governing secretion have been found by experiment to be closely connected with those controlling excretion. Treatment by mechanical stimulation of the one, appears to influence the functionation of the other. In other words, from the side of their neural supplies, treatment of secretion and excretion becomes simultaneous and interchangeable.

In order to avoid repeating here what has been already stated in another place, there is left to be considered in this chapter, therefore, only the *skin* as it is affected through its neural relationship by mechanical stimulation.

The relation of the secretion of the skin to that of the kidneys, is known to be very intimate and important. Abundant perspiration and scanty urine is the usual order in both health and disease. Copious secretion of urine or evacuation from the alimentary canal, coincides with dryness of the skin. But the present consideration has to do with excretion instead of secretion. Here, again, is found the same interchangeability as to neural supply, already referred to.

While the precise nature of all the excretions through the skin in the form of perspiration has not been determined, sufficient is known to establish the fact that the total cessation of this function ultimately leads to death. Insensible perspiration must be maintained at its normal standard to ensure a continuance of health, and at times this must be stimulated to greater activity.

The special nerve fibres governing the production of insensible perspiration or skin excretion, are the 6th, 7th and 8th dorsal (anterior roots) for the upper limbs; and the last three dorsal and first two lumbar, for the lower limbs. The fibres supplying the head, pass in the cervical sympathetic and some branches of the trigeminal.

CHAPTER IX

MUSCULAR METABOLISM

THE process of *general* metabolism is so well understood by the profession as expressing the sum total of the chemical exchanges occurring in living tissues, that it has not seemed desirable to consider it in this work. Landois and Stirling define the process as "those phenomena whereby all living organisms are capable of incorporating the substances obtained from their food, into their tissues and making them an integral part of their own bodies." But they elucidate the subject mainly from the basis of the organs of secretion and excretion. The purpose of this chapter is to consider what has too often been treated, intentionally or otherwise, as a "side-show" of the metabolic process, viz., *metabolism through muscular energy.*

Physiologists concede that, next to the liver, muscular tissue contains the largest amount of glycogen. That glycogen is changed into sugar by the chemical action set up by muscular contraction, is generally accepted and recognized. The importance of glycogen, con-

sidered as an anabolic factor in the process of metabolism, is also now pretty generally recognized. It may fairly be questioned, however, whether it has received the full measure of recognition which its great importance demands. It is to this special feature of *muscular* metabolism, that it is proposed to devote the present chapter. It is to be hoped that from it may be deduced some conclusions which, if practicalized and made operative, may materially contribute to increase the general metabolic process and render possible the cure of diseases that otherwise lie outside of the present recognized limit of curative probabilities.

Heat is considered as one of the essential elements in conserving the vital forces of the body. Considerable difference of opinion still exists among physiologists as to the source of animal heat. Sir Michael Foster says: "Of all the tissues of the body, the muscles, not only from their bulk, forming as they do so large a proportion of the whole frame, but also from the character of their metabolism, *must be regarded as the chief sources of heat.*" He further proceeds to point out that muscular metabolism, which thus helps to regulate temperature, need not necessarily involve *visible* muscular contraction, though the heat will be

increased with every such contraction that occurs. It is to be remembered that in the most quiet body, muscular contractions are constantly going on which ensure the continuous production of heat. Greater muscular activity naturally increases the generation of heat. All writers agree that heat is the product of oxidation, but they differ as to *where* its production principally takes place. It is sufficient for the present purpose, to take what is granted by general consent, viz., that, if not all, at least the *largest quantity* of the heat of the body, is produced in the muscles by virtue of their metabolic function. The source of muscular energy (as also of animal heat) is through the oxidation of the glycogen which muscles contain. The chemical changes which are normally operative in a resting muscle, are greatly increased when it contracts. The most abundant waste product of muscle oxidation is carbonic acid. Sacro-lactic acid is also thus produced, and retention of this waste product, through imperfect muscle oxidation, is held by many writers to be the cause of gout and rheumatism. More will be said respecting this condition, however, a little further on in the present chapter.

Muscular fatigue is believed to be due to the consumption of the substances available

for the supply of energy (oxygen) and to the accumulation in the muscle of the waste product of contraction, of which sacro-lactic acid is, probably, the chief element. Putting the muscle in a state of relaxation, enables the blood current to wash or carry away the accumulation of acid product and the muscle is thus rested, — the fatigue then passes off.

Kirke, in discussing the subject of muscular fatigue, inquires as to *where* it originates, whether in the nerve, the muscle, or in the end-plates? He concludes his consideration of the subject by asserting that it has been demonstrated to be localized in the nerve-endings. He says: "We thus see that the nervous system is intimately associated with the regulation of the temperature of the body. There is at least one centre — there may be several associated in this action. These centres receive afferent impulses without; they send out efferent impulses by at least three sets of nerves: (1) the vaso-motor nerves, (2) the secretory nerves, or the sweat glands, and (3) trophic or nutritional nerves." The cause of high temperature in fever may, therefore, be explained as due neither to increased formation nor diminished discharge, of heat, but rather to an interference with the nerve-reflex mechanism which, in health, operates to equalize

the two. In the light of recent investigation, there seems no longer reason to doubt that the thermic activity of muscles is dependent upon the oxidation of the glycogen stored in them, and also upon the quality of the action of the nerve control of the heat centres in the central nervous system.

But it must be remembered at the same time that muscles possess an *independent power of excitability* which may induce more energetic contractions as *the result of external stimulation.* This may be induced by mechanical stimulus, heat and cold, electricity, and chemical agents. Muscles have, therefore, a dual neural supply, due, probably, to Nature's recognition of the highly important functions which they are designed to discharge in the normal organism. It is to be apprehended that, as a whole, the profession has not always kept pace in the formulation of its theories with the obvious teachings of Nature, and so may have failed to adequately estimate the overwhelming importance of the metabolic process going on in the muscular organization in conserving the health and well-being of the body. The muscular system in its relationship to the will, whereby it executes its commands through the visible expression of motion has, perhaps, received too much

of our thought, to the neglect of its automatic and metabolic characteristics.

Differentiating between them as to quality, we find that in the voluntary muscles (under control of the will), the motor nerve fibres have special end-organs called *end-plates.* The fibre branches two or three times, and each branch goes to a muscular fibre.

In the involuntary muscles (not dependent upon the will but entirely automatic in action), the fibres form complicated plexuses near their terminations. Upon this subject, Gray says:* "Motor nerves may be traced into both striped and unstriped muscular fibres. In the striped or voluntary muscles, the nerves supplying the muscular fibres are derived from the cerebro-spinal nerve and are composed mainly of medullated fibres. A nerve after entering the sheath of the muscle, breaks up into fibres or bundles of fibres, which form plexuses and gradually divide until, as a rule, a single nerve enters a single muscular fibre. Sometimes, however, if the muscular fibre is long, more than one fibre enters it. Within the muscular fibre, the nerve terminates in a space of expansion called by Kühne, who first correctly described them, *motorial end-plates.* The nerve fibre, on approaching the muscular fibre,

* Gray's Anatomy, pp. 78–79.

suddenly loses its white matter of Schwann which abruptly terminates; the neurilemma becomes continuous with the sarcolemma of the muscle, and only the axis cylinder enters the muscular fibre, where it immediately spreads out, ramifying like the roots of a tree immediately beneath the sarcolemma, and is embedded in a layer of granular matter containing a number of clear oblong nuclei, the whole constituting the end-plate, from which the contractile wave of the muscular fibre is said to start."

A diagram, No. 6, in this chapter, illustrating the manner in which the nerve fibre enters the muscular fibre, will be found on opposite page.

Contraction, visible and invisible, is a characteristic of both the voluntary and involuntary forms of muscle, and is controlled by the nervous system. It is important to note, however, that the involuntary muscles are controlled by a different part of the nervous system from that which controls the activity of the voluntary muscles.

Passing now to another phase of this subject, attention is invited, for the purpose of illustration, to the very prevalent and troublesome diseases of gout and rheumatism. There are none which physicians have been called

Plate VI.

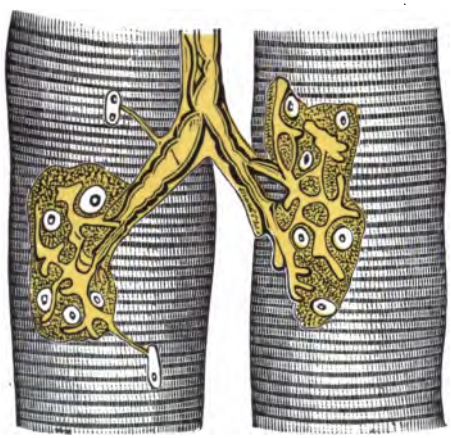

Diagram showing the distribution of nerve fibre in muscular tissue.

(This diagram illustrates the anatomical means through which muscles derive their power of "independent excitability," as described in Chapter IX.)

upon to treat that have probably undergone, within the past decade, as many changes in the choice of agents and methods of treatment, as the diseases just named. Nor has treatment always been restricted to those agents or methods which strict scientific investigation sanctioned. Empiricism has sometimes been invoked out of sheer despair at lack of success with the more rational methods of treatment. Nevertheless, the therapeutics of to-day do not seem to be very much nearer a satisfactory solution of the problem of *how* to cure gout and rheumatism than were those of a quarter of a century ago.

These diseases are believed to be due to an excess of an acid — lactic, sacro-lactic, or uric — in the blood which it is unable to throw off with sufficient rapidity to prevent its accumulation at local points in the body and there setting up inflammation. The drug treatment of these conditions has, it would seem, been largely in the direction of neutralizing or dissolving the excess of acid *in the blood,* for the medicament could scarcely be expected to reach the *affected joints* in sufficient quantities to effect that purpose there. Patients have oftentimes drunk the various lithia and anti-acid waters, natural and artificial, by the gallon and, in some instances, even by the

barrel, and yet still continued to suffer from gout and rheumatism. The same is also true in respect to restricted diet from which all acid-producing foods had been largely, if not wholly, excluded. The gout and rheumatism, however, usually continued, uninfluenced, appreciably, by such regimen.

Have not the methods of treatment of these diseases been too much in the direction of dealing with *effects* rather than in attempting to discover and grapple with the *causes?* There would seem to be little utility in administering drugs to neutralize an excess of acid with the hope of *curing* gout and rheumatism so long as the excessive production continued. But, it may be replied, that the source or site of the excessive acid production can rarely be determined with absolute certainty. As a matter of fact, it usually is not determined. But while this is true, it is also equally true that all abnormal secretions, whether quantitative or qualitative, are known to be due to defective metabolism. If general metabolism could be stimulated — as it unquestionably can be through mechanical stimulation — would not the excessive manufacture of acid be diminished or cease altogether? But, again, would the stimulation, if attempted, need necessarily to be *general* — to embrace

the entire metabolic process of all the tissues and organs of the body? Too often the liver and the kidneys are stimulated with this object in view when even an interval of serious consideration in another direction would suffice to remind us that neither of these organs is *primarily* concerned in the *production* of either lactic or uric acid. Physiologists are to-day as far as ever from being able to locate, definitely, the centre of the production of urea! Nearly all authorities believe it to be the resultant product of *general* metabolism. Certainly neither the liver nor the kidneys manufacture it in any very considerable quantity, although it belongs to the function of the kidneys to eliminate it.

Experience has demonstrated that there are two effective methods of treating gout and rheumatism by mechanical stimulation. One is by the stimulation of the nerve centres controlling tissue and organic metabolism, *but preëminently those controlling muscular action,* and, at the same time, carefully searching for contractures in the muscles themselves and when found, relieving them. The other method is by the application of stimulative treatment directly to the lymphatics and the organs of excretion. Gout

and rheumatism in aggravated and somewhat chronic forms, have been frequently cured by the intelligent application of either method. In the writer's experience and observation, the most prompt and satisfactory results have followed where treatment was simultaneously applied with a view to stimulating both muscular metabolism and excretion. If defective metabolism can be corrected and made normal, excessive acid secretion will assuredly not occur, for the natural chemical processes of the body are, of course, perfect when not inhibited or interfered with. But if interference should supervene, it could work no great harm to the organism so long as the excessive products are promptly eliminated, no matter whether they are chemically neutralized or not. Obviously, removal of the cause here as elsewhere, is the better because the natural, method of treatment. That this can be accomplished by mechanical stimulation in a large proportion of probably otherwise incurable cases of rheumatism and gout, is the writer's opinion and pleasant privilege and duty now to announce.

With all the accumulated and still accumulating, volumes of morphological and pathological data, it is fairly probable that only a fraction of the many chronic and in-

curable disorders that affect the body and which are largely *due to continuing defective muscular metabolism,* have been recognized and so classified. Usually a more obscure and problematic explanation is given of the origin or cause of such diseases. Scientific experimentation suggests that a method be now tried in efforts at cure, that is at least theoretically rational and which has been sustained and reinforced by the conclusive logic of demonstrated curative results. General stimulation should be applied to *all* the nerves controlling the process of general metabolism, with special attention to those concerned in and controlling, muscular action. Any principle of metabolic stimulation that overlooks or minimizes the muscular system, is faulty in theory and must inevitably prove disappointing in practice.

The practical conclusion of this brief consideration is that muscular metabolism, of which heat is the most important product, is essentially under the control of the central nervous system, and that it is susceptible to stimulation as well as the muscles themselves. Muscular stimulation, as experience has abundantly demonstrated, can be most effectively applied to the vaso-motor areas in the spinal cord by means of mechanical vibration. It

cannot, in the opinion of the writer, be done so effectively by any other physical method known at the present time. Although the muscles are dominated and controlled through the central nervous system, it is important never to lose sight of the fact that they possess, as has already been pointed out, an *independent excitability* which, under proper stimulus, induces contraction. It is for this reason that in treating muscular contractures, mechanical stimulation should be applied over the site of the contracture as well as to its proper nerve centre in the cord. It ordinarily requires only a short time to relax a muscle which has been in a more or less chronic condition of contracture for weeks or months. The treatment should be made by deep pressure, *with a long vibratory stroke,* and continued from one to two minutes, or until the contracture has appreciably relaxed, as disclosed by the sense of touch.

CHAPTER X

THE NERVOUS SYSTEM

THE nervous system may be said to be divided into two parts, — (1) the central nervous system, and (2) the peripheral nervous system. The *central* nervous system consists of the brain and spinal cord and its connections; the *peripheral* nervous system embraces those nerves which conduct the impulse to and from the central nervous system, thereby bringing the nerve centres into relationship with other parts of the body.

The nerves transmitting the impulse *from* the nerve centres are called *efferent;* those which conduct the impulses *to* the nerve centres are called *afferent.*

The nerve centres are composed of the brain and spinal cord. They contain nerve-cells from which the fibres of the nerve originate. Small bundles of nerve-cells are also found in various portions of the peripheral nervous system which are known as *ganglia.* The posterior roots of the spinal nerves have a spinal ganglion which must be differentiated from ganglion of the sympathetic-ganglionic system.

At the point of union of each pair of spinal nerves within the intervertebral foramen, is given off a branch that returns to the spinal dura mater, into which its fibres become embedded.* This is believed by some authorities to be the *trophic nerve* supply of the central nervous system, and is affected by the stimulus imparted to it through the posterior division of the spinal nerve lying between the vertebral spinous process.

The precise *modus operandi* of the functionation of trophic nerves, has never been satisfactorily determined. Considerable confusion consequently exists at the present time respecting their precise mode of action. For example, we know that it is not the trophic nerve itself, but the *character of the nerve-cells of the part to which the nutritional stimuli is conveyed,* that forms a finger-nail in one place, or grows a hair in another, or muscular tissue in still another place. It is nevertheless, in its totality, the same nerve, irrespective of the character of the business it is carrying on. In determining the etiology of a localized eruption, for example, the question will naturally arise as to whether it is due to interference through muscular contraction with the trophic nerve supplying the

* Gray's Anatomy, page 827.

eruptive area, or to the dormant or inactive condition of the lymphatics which drain the affected part? It is obvious that it would be almost impossible to always accurately locate the cause unless the muscular contractures were very marked. Even then it is quite possible that the eruption might be due to both causes combined. Unless the cause is so manifest as not to admit of the possibility of error, it will be found better practice to stimulate both the suspected muscular area and the lymphatics.

There are twelve pairs of nerves originating in the brain, known as the *cranial nerves.* They are nerves of special sense, but some of them supply the region of the head with motor and sensory fibres. The tenth cranial nerve, known as the *pneumogastric,* or *vagus,* is distributed mainly to the viscera of the thorax and abdomen. Part of the eleventh, or spinal accessory cranial nerve, unites with the pneumogastric before it leaves the region of the head.

Nerves are said to be *irritable* when they are functionating normally. That is to say, when they are stimulated by any sufficient means, a disturbance or excitement is produced in their constituent cellular elements. This change is known as an impulse, and is

propagated along the course of the nerve. The change is wholly molecular, inasmuch as the most powerful microscope has never been able to detect it. The irritability of a nerve is determined by the results produced in the organ or part by the impulse transmitted to it. Stimulation of a motor nerve produces a nervous impulse in that nerve which, when it reaches a muscle, causes it to contract; stimulation of a sensory nerve, on the other hand, produces an impulse in that nerve which, when it reaches the brain (or the cord), causes a sensation to be transmitted.

Respecting "nerve-motion," Landois and Stirling say:* "The physiological or normal stimulus excites the nerve in the normal intact body. *Its nature is entirely unknown.* The 'nerve-motion' thereby set up travels either in a centrifugal or efferent or outgoing direction from the central nervous system, giving rise to motion, inhibition of motion or secretion; or in a centripetal or afferent or ingoing direction from the specific end-organs of the nerves of special sense, or the sensory nerves. In the latter case, the impulse reaches the central organs, where it

* Landois & Stirling's Text-Book of Human Physiology, page 678.

may excite sensation or perception, or it may be transferred to the motor areas, and be conducted in a centrifugal direction, constituting a reflex stimulation."

Thus far in treating of the various physiological functions of the body, the writer believes he has been in substantial accord with the views held in more recent times by the best writers on physiology. At this particular point, however, and in the succeeding chapter on the Spinal Cord, it is only fair to state that the reader may expect to find some points of sharp divergence.

It is here contended, *first,* that the sensory impulse is *not necessarily* communicated to the brain at all in order to produce sensation; that there are centres or stations of intelligence and direction *within the cord itself* that can and do attend to and direct the exercise of sensation and will without necessarily calling the brain into requisition at all. *Second;* it is also contended that the various viscera of the body are controlled *through nerve centres located in the spinal cord. Third,* it is further contended that an irritation in a distant viscus or part, *is reflected back to the nerve-centre in the cord and is there disclosed by the sensitiveness of that nerve or nerve-centre, to pressure.* Without endeavor-

ing at this time to present anything in the nature of an argument to support these propositions, they are simply submitted now as postulates, predicated upon the results of a somewhat extensive experimental investigation along the lines herein and to be hereinafter indicated.

Attention is invited, in this connection, to Plate VII, opposite page 112, which will, it is hoped, indicate the somewhat complex structure of a nerve, and illustrate how it is affected by mechanical stimulus, and the proper point for its application for reflex effects.

CHAPTER XI

SPINAL CORD

In considering the theory upon which treatment by mechanical stimulation is based and proceeds, the spinal cord may, without the slightest exaggeration, be said to be of *paramount* importance. Before proceeding to consider it in its relationship to this treatment, a brief review of its structure and physiology would seem to be pertinent and advisable, and will, it is hoped, afford the reader a clearer and a better understanding of the rationale of the application of treatment by vibratory stimulation.

The spinal cord is practically an elongation of the brain. It is a column of nerve-substance connected with the brain through the medium of the bulb, and situated in the spinal canal. As a matter of fact, it is a continuous brain throughout its entire length. It has two enlargements, one in the cervical and the other in the lumbar region. It is from these points that the large nerves supplying the arms and legs are given off. Near the lower border of the first lumbar vertebra, the cord

terminates in a slender filament of gray substance called the *filum terminale,* which is embedded in the mesh of the roots of many nerves which form the *cauda equina.*

The cord is composed of white matter on its exterior, and of gray matter in its interior. The gray matter is arranged like two crescentic masses, the horns of which are called the *anterior* and *posterior cornua.* They are connected together by a narrow portion called the *posterior commissure.* Passing through the center of this narrow isthmus longitudinally, is a minute canal. This central canal is continued throughout the entire length of the cord. Above, it opens into the fourth ventricle of the brain, which is immediately posterior to the medulla oblongata and pons varolii. This canal contains the cerebro-spinal fluid.

The spinal cord consists of two halves. Each half is marked on the side by two longitudinal furrows which divide it into three portions or tracts, an *anterior, lateral,* and *posterior* column. From the groove between the anterior and lateral columns arise the anterior or motor roots of the spinal nerves, while immediately in front of the groove, between the lateral and posterior columns, the posterior or sensory roots take their origin.

On each side of the vertebræ of the spinal column, a pair of roots is given off, — about thirty-two pairs in all.

On each side along the front of the vertebral column, lies a ganglion or chain of nerve branches known as the *sympathetic nerve.* They are formed of filaments derived from the spinal nerves, with which they are in relationship throughout the entire length of the cord. That is to say, there are on the sides of each vertebra, directly on the heads of the ribs along the sides of the column, a pair of sympathetic nerves corresponding to each pair of spinal nerves. Histologically, according to Paterson, the sympathetic system at first has no connection with the cord. Subsequently it becomes connected to the cord by the ingrowth into it of the splanchnic branches of the spinal nerve, and after this connection is made, it assumes a segmental appearance.

The sympathetic nervous system embraces (1) a *central part,* consisting of a series of ganglia situated, as already stated, on each side of the spine and connected by a nervous cord; (2) nerves that pass from this chain to the viscera; and (3) plexuses or "bunches" formed by these nerves either about the vessels, or within the substance of the viscera,

which contain numerous small ganglia. It is well to remember, in passing over this branch of the nervous system, that ganglia are more than mere aggregations of nerve cells. They contain gray matter, and are believed to send out nerve impulses that stimulate organic and psychic action. Many psychologists claim that the ganglia are the centres of psychic impression and the transmitters and receivers of intuitive knowledge.

There has been a tendency among physiologists in the past to minimize the importance of the spinal cord and to unduly exalt the brain as the exclusive directing and controlling factor in the physiological processes of the body. But they are apparently coming now to recognize that even some of the processes of the brain itself receive their nutriment and impetus from the cord. For example, Leonard Hill says,* "The velocity of the blood-flow through the brain is thus influenced markedly by the condition of the vessels of the splanchnic area."

The limits and purpose of this book will not permit of very much in the nature of argument designed to sustain hitherto disputed or newly assumed positions in histology and physiology. Inasmuch as these pages

* Kirke's Physiology, page 278.

are intended merely as suggestive outlines for the proper application of mechanical-vibratory treatment, and are based, for the most part, upon theories which experience has proven to be correctly taken, many of the propositions which they contain must necessarily be stated somewhat didactically. Proceeding, then, upon this basis, the functions of the spinal cord may, for convenience, be summarized as follows:

1. It is the principal seat of reflex nerve action.

2. It is the centre of the vaso-motor system.

3. It exercises an automatic action over the arterial tone and various viscera.

(All the functions considered in the preceding chapters are controlled by nerves originating at various points along the spinal cord.)

4. *It is the index of abnormal action in many parts of the body.*

Relative to the last proposition, it may be confidently asserted that, however unorthodox this position may, at first blush, appear to the average reader, it is nevertheless true. In almost every disturbance of the organism, irritations of more or less intensity in organs or areas in various and re-

mote parts of the body, will be found reflected along the course of the nerves of the spine controlling the nutritional and muscular action of those affected parts. This reflex action applies in reference to affected parts generally, regardless of the distance of their location from their spinal center. In chronic disease of the viscera, the spinal muscles lying over the reflexly affected spinal nerve-centre, will generally be found contracted, and if long continued, more or less atrophied. This is due to the fact that the nerves supplying the contracted muscles originate in the same area in the cord that is reflexly affected from the irritated viscera and, consequently, participate in the irritation to which they give rise.

When the diseased condition of the viscera is of great intensity, or of moderate intensity but *prolonged,* their nerve-centres in the cord become partially inhibited and lose the power to normally functionate without the application of added stimuli, which, in such cases, must be artificially applied directly over the affected centre.

While preparing this manuscript, a case of sprained ankle came under observation which very strikingly illustrates the accuracy of the proposition now under consideration. The

accident occurred about a month previous to the patient coming under observation. The ankle had been treated in the usual surgical way. The patient was still wearing a tight bandage carried well up toward the knee. After the lapse of a month, the ankle was apparently as badly swollen as shortly after the accident. Examination of the lower part of the spine, over the origin of the sciatic nerve (which transmits, in part, the neural stimulus to the ankle), disclosed marked atrophy of the muscles lying in this area, and great sensitiveness of the spinal nerves to pressure. In addition, the gluteii muscles were also found to be markedly atrophied. The atrophy was so pronounced, indeed, as to be noticed and commented upon by the patient's friends who were present at the examination. The muscles of the lower limbs were also considerably reduced. The spine over the origin of the sciatic nerve was very sensitive to pressure. Here was a case where shock and irritation had been communicated from the ankle to the spinal nerve controlling its nutrition and sensation, and the partial inhibition thus set up, had initiated an atrophic process in the muscles of the thigh which received their nutrition from this reflexly irritated nerve-centre. Atrophy is bound to

inevitably follow continued abridgment of nutritive supply. Conditions similar to this are of frequent occurrence in connection with sprains of the ankle and wrist. They very aptly illustrate the application of the principle that it has been attempted here to state, and which it may be well again to repeat, viz., that a chronic irritation at the periphery or in a distant viscus, is usually communicated to that nerve-centre in the spine which controls its nutrition, and is disclosed through *extreme sensitiveness to deep pressure.* The reflex spinal irritation here referred to, is the sequence of *chronic,* rather than acute, abnormal action in a viscus or area. This is probably because the effect of the reflex irritation is experienced only after the nutrient fibres of the injured muscle begin to suffer in consequence of denutrition. The element of *time* is necessary before the "starving process" in the local nerve fibre is sufficiently advanced to set up the irritation that becomes finally reflected back to its controlling centre in the cord.

Irritation of the nerves along the third and fourth cervical will, for example, cause disturbance in the visual organs. On the other hand, abnormal conditions in the eye will produce irritation, as shown by extreme sen-

sitiveness to pressure, in the same spinal area. Again, disorders of the liver will almost invariably be found associated with extreme sensitiveness over the third to the eleventh dorsal nerves. This proposition did not originate with, nor does it emanate from, the exploiters of a sensational or irregular therapy, but, on the contrary, is formulated as the outgrowth of extensive experimental investigation pursued along strictly scientific lines. *It is also reinforced by the corroborative opinions of many of the most recent as well as the ablest writers on the subject of physiology.* If the statement of this proposition should strike the reader as bizarre, let him submit it to the crucible of practical test. If he will do this with thoroughness, it will not be very long before it will become part of his regular and undeviating examination-routine to carefully examine the spinal cord for points of sensitiveness or for muscular contractures. When they are found and properly vibrated or stimulated, the striking benefits of mechanical therapy will become manifest to a degree that is not otherwise possible. All the functions of life, — circulation, respiration, lymphatic drainage, secretion, excretion, muscular and tissue metabolism, temperature, etc., — may be thus

reached and stimulated, and normal equilibrium thereby reëstablished.

The writer is not unaware that the fact that a class of irregular practitioners called "osteopaths," manipulate and treat the spine, tends to incline the profession to look dubiously upon anything that savors at all of their methods of procedure. Such objection, it is submitted, is neither reasonable nor conclusive. The "osteopaths" did not invent or discover the spinal cord or its nerves and ganglia. Because they attempt to manipulate the nerve-centres in the cord, does not, it is submitted in all fairness, constitute a valid reason for any physician's refusal to make it the field of his operations, if such procedure has the sanction of investigation and experimentation conducted in accordance with scientific methods. Such refusal would be as illogical and unreasonable as to discard the use of drugs because patent medicines or quack nostrums are sold and used. Besides, if there is the least merit in so-called osteopathy, that merit should be appropriated by the medical profession and applied to the benefit of its patients. There was probably never a great popular error that did not contain some germs of valuable truth. The error ordinarily consists in thinking and assuming

that it contains *all* the truth. It is to be remembered, too, that every procedure in regular medicine — therapeutical or surgical — may be, and many of them have been, malingered by irregular or unethical practitioners. But would that constitute a sane reason for the rejection by a physician, without a fair investigation of its merits, of anything even *purporting* to possess curative value, and which asks recognition only by virtue of the practical tests which it invites and upon the results of which it is willing to rest its claims and be judged? Besides, as has been repeatedly shown throughout this book, most of its propositions are supported by well and generally recognized principles of physiology and by the more recent writers on that subject. They are, therefore, for the most part at least, legitimately exempt from the discredit (?) and suspicion that would otherwise attach to them in the minds of those scientific (?) and learned gentlemen of our profession who constitutionally discountenance anything that bears the disqualifying (to them) *imprimatur* of either newness or *originality!!* It may be remarked, *en passant,* that it is this attitude of mind and action that is largely responsible for the birth and prosperous growth of the various irregular sys-

tems and methods of treatment and practice now so greatly extant.

Experience has repeatedly demonstrated to the writer, as it will to the reader if he will carry out the recommendations of this chapter, that treatment applied to the nerve centres of the spine, *especially to the areas of sensitiveness to deep pressure,* is the pivotal point in the therapy of mechanical stimulation.

The frontispiece diagram, Plate I, was prepared for the special purpose of showing the exact nerve-centers in the spinal cord which control the action of the different organs and areas of the body, and to better illustrate and emphasize the contentions of this chapter. It is hoped that frequent reference will be made to it by the reader in connection with his consideration of the various chapters of this book.

CHAPTER XII

NERVE STIMULATION

It cannot be reasonably or fairly expected that the laity should entertain very accurate notions concerning the structure and functions of the human body, even though the basic principles of anatomy and physiology are now and have for some considerable time been taught in the common schools. Nevertheless, there is a great deal of fallacy and error exploited by them as anatomical and physiological fact. There is no part of the physical organism, probably, concerning the functions and structure of which people "know so much that is not true" as in relation to the nervous system. It is because of the wide prevalence of inaccurate information respecting it, that so many cant phrases are current like, for example, "nerve tonics," "nerve builders," "nerve foods," "toning up the nerves," and so on almost *ad infinitum*. It is to be sincerely regretted that the profession, as a rule, has been so busily engaged with other matters as to neglect making a systematic attempt to correct many of these

popular misconceptions respecting the anatomy and physiology of the body. Had it done so, the field for quackery and patent nostrums would long since have ceased to be as promising and remunerative as it still continues to be. Patients solemnly assure their physicians that they are "nervous" or nervously "prostrated" (oftentimes when bicycling or golfing!) and need a "nerve tonic," without even an approximately accurate idea of the physiological meaning of such words. Physicians ought, in justice both to themselves and their patients, to correct, by proper explanations, such inexact statements and phrases. Probably not every physician who thinks about "nerve stimulation," pauses himself sufficiently long to analyze all that it comprehends or involves.

What is nerve stimulation? How is it accomplished? What agents at our command are available for its accomplishment? These inquiries and their correct answers are believed to be most pertinent, and also very important, to the proper consideration of the subject of which it is the design of this book to treat.

Throughout the preceding chapters, the principal physiological functions of the body have been briefly outlined. But they all turn at

last, as we have seen, for their normal and efficient action, upon the pivot of *nerve supply*. Followed out to its ultimate conclusion, each function is dependent upon adequate nerve supply for normality of action. We have thus reached the origin of active physiological function — the source and maintenance of all activity in the body. For instance, it is well known that stimulation, when applied to the posterior branch of a spinal nerve, *travels toward the centre,* and when it reaches the junction of the anterior and posterior roots in the intervertebral foramen, the impulse is conveyed to the anterior division of the spinal and sympathetic nerves which supply the periphery and viscera, and also to the recurrent branch that supplies the dura mater.

The impulse produced by stimulation of any nerve, it should be remembered, is always greater when initiated at the centre from which it emanates and by which it is controlled, than when applied directly to the nerve (branch) itself. This is due to the operation of the law governing the transmission of all neural sensation: that the greatest impulse is exerted at the center rather than at the periphery, or at any point between them. As was seen in the chapter on the Nervous System, it is an orderly but at the same

time a very complex arrangement of nerves that dominates the body. Reduce any function or the activity of any organ to its "lowest terms," and it leads back at last to its nerve supply. It is the starting point of all activity in the human body.

It may very pertinently be asked what the natural stimuli or motive force operating upon nerves really are? The answer can at best be only speculative, because it is not susceptible of physical demonstration. What is that subtle force or influence which "makes the organism go?" Evidently the nervous system must be "started," so to speak, by forces outside and independent of the body. Under normal conditions, it responds to that influence, whatever that may be. It is generally believed and scientifically recognized, that hearing and sight, for example, are the results of rapid vibrations in the universal ether. Physicists say that the ether here referred to, is a medium filling all space through which the vibrations of light, radiant heat, and electric energy are propagated. This medium, whose existence most authorities now consider to be established, is thought to be more elastic than any ordinary form of matter and to exist throughout all known space, even within the densest bodies. Electric and magnetic phenomena are ex-

plained as due to strains and pulsations in the ether. Why may it not reasonably be supposed that the *vis a tergo* — the vitalizing force behind the anatomical structure of a nerve and which "makes it go," — is a part of this same operating cause? Nerves must draw their vitality from some never-failing reservoir, otherwise the breaks in the continuity of physical life would be of such frequent occurrence as would very soon complete the extinction of the human race. The waves of the universal ether are said to be in constant and rapid vibration. If sight and sound are dependent upon these vibrations, why may not normal neural impulse also be?

As has already been seen in a previous chapter, it is conceded by physiologists that there is a process of *invisible* muscular contractions constantly going on, even when the body is in a state of rest. Is it not equally logical and reasonable to assume that there is also a process of nervous vibration that is continuously operative (although physically inappreciable) which maintains the organs of the body and their functions at par? When, from any cause, nerves become lethargic or partially unreceptive to this continually exerted outer "ether" current or stimulus, impairment of organ and function ensues.

The impairment cannot be due to any diminution in etheric pressure because, like the oxygen of the atmosphere, that is unfailing and incapricious in its supply. Moreover, were it not so, the whole human family would suffer similar lapses at the same time. Consolidated air vesicles in diseased lungs fail to absorb oxygen in sufficient quantities to aërate the blood and sustain normal tissue metabolism, but an undiminished supply continues in the universal atmosphere, nevertheless. In some such analogous way, nerves may become temporarily or permanently disabled and so unable to appropriate their natural stimuli. At all events, when Nature weakens in her activities, it is the province and mission of all true therapy not to supplant but to *assist* her just when and where enfeeblement becomes most manifest. Natural methods of help are always to be preferred to artificial means. The real reparatory power resides alone with Nature, and though at times she falters, she never abdicates her prerogatives until physical life is extinct. She may be assisted, but can never be successfully supplanted in her efforts at recuperation and repair. In the last analysis, then, it is Nature that is the supreme and *only* healer. If, therefore, nerves require stimulation, obviously it is wiser to attempt to supply it by

manual or mechanical vibration than through the more roundabout methods of drugging, forced alimentation, and other unnatural as well as uncertain, modes of treatment.

As a matter of physical fact, nerves are found readily responsive to the electric current. It has come to be one of the important diagnostic agents in the hands of the neurologist. With it he makes his tests for the *reaction of degeneration.* Whatever else may be claimed for electricity, for the diagnostic purposes here referred to, it is essentially *vibration.* While the electric current gives the reaction of nerve degeneration, it does not disclose mere *irritability* of nerve fibre nor localize reflexly irritated nerve centres in the spine. This is disclosed alone by deep pressure over the site of the nerve, and is best applied by means of the thumb or second finger.

Nerve substance responds to pressure vibration. It seems logical to conclude, therefore, that that is its natural stimulus. The entire nervous organism is maintained and kept in "running order" through the element which apparently inheres in it, and which causes it to attract vibratory stimuli and also to respond to it when artificially applied.

Earlier in this chapter, the inquiry was propounded as to what nerve stimulation really

was, — how a nerve could be stimulated? Obviously, it can be done by imitating as nearly as possible, the natural method, if that could be definitely known. But leaving now the speculative side of the question entirely aside, it is a matter of repeated practical demonstration that pressure *does* impart stimulus to a nerve. For example, light pressure exerted over the pneumogastric nerve along the side of the neck, immediately above the sternum, produces a cough, — the effect of reflex pressure stimulation. So, also, a sharp blow on a nerve will accelerate or stimulate its action. If greater pressure is made, a sedative effect follows; and if the pressure is sufficiently prolonged, *inhibition* results. Inhibition may also be produced by moderate pressure and a long stroke.

Upon the general subject of nerve stimulation, Landois and Stirling say:* "The following are the various kinds of general stimuli, *i. e.,*

Modes of motion which act upon nerve:

1. Mechanical;
2. Thermal;
3. Chemical;
4. Physiological;
5. Electrical."

* Text-Book of Human Physiology, page 76.

"Nerves possess the property of being thrown into a state of excitement by stimuli, and are, therefore, said to be excitable or irritable."

In view of the foregoing, it would seem that when, through any cause, the normal tone of a nerve is reduced and artificial stimulus is required, that it should be of a *quality* as nearly approaching its natural stimuli as is possible. The natural stimuli, as has been seen, is unquestionably vibratory if not actually mechanical, in character. It would logically follow, therefore, that the artificial stimulus ought to be similar in kind. It is quite true that the pressure or blow that is applied to a nerve does not impart to its cells any *new quality* or element claimed by a class of enthusiasts in behalf of some other forms of artificial stimuli. It cannot be said to be established that the electric current (now very properly coming into rapid therapeutic favor) when applied to a nerve, carries any new element into its cells or contiguous tissue, or excites any chemical reaction that is not already a present element in natural functionation. When the galvanic current is applied for the production of cataphoresis, for instance, there is introduced into the body (ordinarily at the positive pole) not a new element in chemical elaboration, but only

the physical property contained in the drug, the action of which, as in the treatment of cancer, is destructive rather than reactive or chemical. It has never been proven that electricity produces any chemical change in the cellular substance of the nerve itself or in muscles, nor is there any proof that would justify a belief that such a change, even if it were possible, is either necessary or desirable.

It should be stated in this connection, however, that the more experienced and able electro-therapeutists do not contend that the application of the electric current to the body introduces into it a "new element," or does anything chemically except to stimulate or modify *natural* exchanges. The contention, therefore, that electricity is susceptible, when introduced into the body, of initiating new processes of chemical elaboration not already inherent and operative within the organism, proceeds from the over-zealous rather than from the abler electro-therapeutists. It is to be sincerely regretted, however, that this error in respect to the capabilities of electricity as a therapeutic agent, should have become so widely current as it unfortunately has.

Electricity certainly cannot stimulate a nerve to perform that which is outside of its normal function. If it could, it would be an agent of

Plate VII.

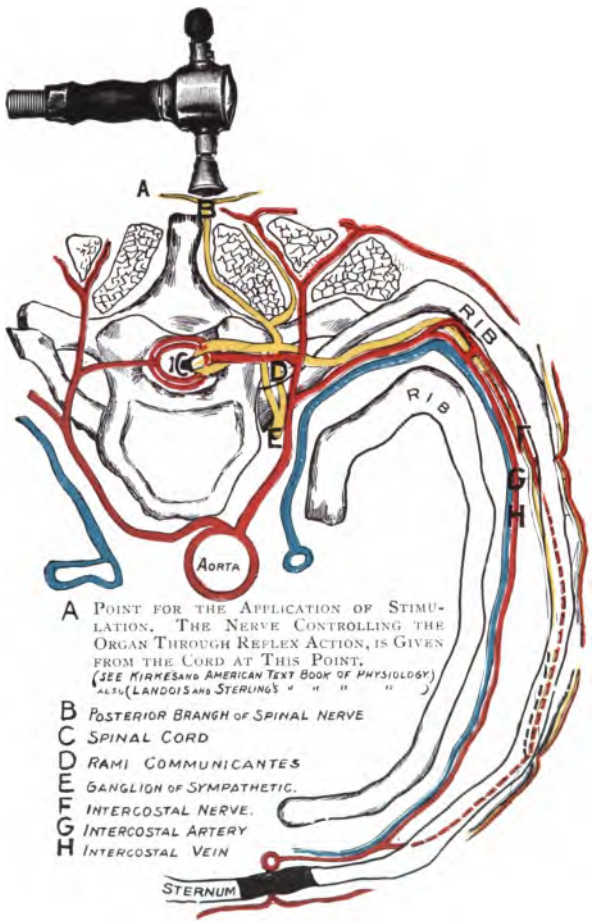

Diagram showing the neural path over which vibratory stimulation travels, and the proper attachment to be used in applying mechanical vibratory stimulation to a spinal nerve.

perversion and be utterly unsuited to therapeutic uses. Nature is her own best chemist, and, under conditions of normal activity in the various organs and functions, is abundantly able to elaborate all the exchanges that the well-being of the body requires. When inactivity occurs in an organ or function, all that a physician can or should attempt to do, is to apply that agent which will stimulate a greater degree of *physiological* activity. Electricity when applied to a trophic nerve, for example, even though it were capable of introducing a new chemical element or exciting a reaction outside of the processes of ordinary functionation, could not make that nerve perform the work of a vaso-motor or a secretory nerve! And if that highly undesirable event were even only occasionally possible, electricity would thereby become too dangerous ever to be employed as a therapeutic agent. It would seem, therefore, that, like mechanical vibration, electricity only stimulates *natural* processes, but which it does not possess the power in any wise to alter or change. It can stimulate or modify *when abnormal,* but is otherwise impotent to effect bodily changes. Mechanical vibration performs precisely the same service, but oftentimes with much greater energy; and yet it is not contended that *of itself,* it

excites new chemical exchanges, or that it is capable of doing so, except in so far as it stimulates the elaboration within the body of those inherent natural processes that may produce them.

Much is justly claimed by climatologists from residence in particular localities in the way of improvement and cure of certain diseases. It is generally recognized that a proper change of climate offers the only possible hope of recovery in several varieties of disease. It is a most potent agency in reparative processes. But, here, again, the element of repair (climatic) is seen to be a natural one, stimulating or modifying but not in any wise changing, the *natural* physiological or chemical processes of the body, through which alone a cure is evolved.

The essential factor both in the mechanical stroke and in the electric current as regards their effect on nerve tissue is, it would seem, *intensified* natural vibration.

A great deal has been accomplished electrolytically with the galvanic current. The very successful treatment of urethral and rectal strictures and prostatic and vesicle inflammations affords a striking example of the capabilities of the constant current in competent hands. Considerable harm, it is quite true, has, at times, been done with it, but this has

been due to a lack of skill in the technique of its application and in estimating the proper dosage rather than because the method of electrolysis is dangerous *per se*.

Dr. Robert Newman, of New York, is perhaps the most prominent of the very few physicians who have been successfully practicing electrolysis for any considerable period of time. His practice of this specialty has extended over a period of more than a quarter of a century, and he is able to report a surprisingly large percentage of successes without the record of a single injury to a patient through *his* application of the current. Doubtless a similar record might be made by practitioners generally if the same degree of intelligence and skill were exercised that has characterized Dr. Newman's work from its very inception.

In the treatment of stricture by electrolysis, (taking Dr. Newman's method as a standard, than which there certainly can be none more worthy to be so taken) it is to be observed that the application of the current is never carried to the point of cauterization. The number of milliamperes of current employed is only that which is sufficient to *stimulate* but insufficient to produce caustic effects! The stricture is thus removed through a process of absorption — a natural method —

rather than through a destructive or unnatural method.

The practical point to be here emphasized, in connection with the consideration of the electrolytic action of electricity, is that in the treatment of strictures and similar conditions, the treatment would appear to be only another form of vibration, but applied *internally* to mucous surfaces for the removal of abnormalities of an obstructive character. This it accomplishes, it would seem, through stimulation or modification in some, at present, unexplainable way, of the natural processes inherent in the part to which the current is applied, precisely as is done *externally* through the application of mechanical-vibratory stimulation. Although it is recognized that with the galvanic current acids collect at the positive pole and alkalies at the negative pole, this fact would not seem to be the important factor in the accomplishment of the results above mentioned, inasmuch as great care is always exercised by skillful operators not to destroy or even mildly cauterize, the parts to which the electrode is applied. Electricity is, as has been already seen, essentially vibration, no matter what additional qualities may be imputed to or claimed for it. It is true that the galvanic current does not, because of

the constant quality of its flow, convey the same external evidence of its vibratory character that characterizes the high frequency current of static electricity, now so deservedly popular and about which so much is being said and written. Nevertheless, electricity of every variety is recognized as being essentially a form of vibration, whether sensibly appreciable or not. The finer the quality of its vibrations, probably, the deeper is its penetrating power. Every electro-therapeutist knows that the galvanic current possesses a power of penetration not possible with the high frequency or high potential currents of static electricity, and which its most ardent advocates do not claim for it.

It should be remembered, in this connection, that while mechanical vibration relaxes contracted muscular tissue and by thus removing pressure, liberates nerve fibre, leaving the nerves free to functionate, electricity, although partaking largely of the same vibratory quality, has not been found in practice to possess this power, or if possessing it, does not perform that service with the readiness and energy that is usually required. A very little experimentation will suffice to demonstrate the entire accuracy of this statement. There is, therefore, that important difference, as regards effects

upon muscular contractures, between the vibrations of electricity and those produced mechanically. That difference is probably due to the length of the stroke and to the pressure necessarily exerted in applying the mechanical method of treatment rather than to any radical difference in the character or quality of the vibrations.

Dr. William Benham Snow, of The New York School of Physical Therapeutics, one of the recognized and foremost authorities on the subject of static electricity in this country, in speaking of the vibratory quality of electricity, says: * "The effects upon metabolism of vibratory influence has long been recognized by physiologists, such as are attributed to the heart's impulse. Dubois-Reymond taught that the nutritional effects depend not on the quantity of the electricity, but upon the *variations in the quantity* and the *suddenness* of these variations."

It will be observed that in mechanical vibratory stimulation the desideratum above specified of "variation in quantity" may be and is provided for by means of the adjustable stroke. The "suddenness of variations" is also provided for in the rapidity of the vibrations, being in most instruments, from 1,750 to 2,500 per minute.

* Static Electricity—Snow, page 47.

But, as was stated in the introductory chapter of this work, treatment by mechanical vibration is not claimed to be a "cure-all" (although its range of usefulness is very wide and comprehensive), or to embody within itself *all* the qualities essential for successfully treating disease. While it may be said to parallel many of the qualities claimed for electricity, particularly the static current, it does not aspire to do the work now being so well performed through electrolysis and cataphoresis, for example. Neither does *static* electricity so aspire, for that matter, because on page 47, of his recent book, which is certainly the latest as well as the ablest presentation of that subject extant, Dr. Snow, in speaking of these qualities, frankly says that they "*are practically impossible to obtain with Franklinism.*"

Vibratory stimulation may be applied to the body in various ways. Whatever the method of its application, its quality is uniformly the same. But it is worth noting again, in this connection, that the quality of the stimulation imparted to the nerves does not depend so much upon the rapidity of the vibrations as upon their length. Manufacturers of mechanical vibration instruments have been disposed, apparently, either to overlook or minimize this

factor, or else to disbelieve it altogether. Notwithstanding, it is a fact of first importance. Whatever other features a vibration instrument should possess, it is of the highest importance that it be provided with some device whereby the length of the stroke may be readily lengthened or shortened as the necessities of a given case may seem to dictate. Of equal importance is the necessity for some provision whereby the rigidity of the instrument may at all times be maintained, which alone ensures *deep penetration* of the stimulus excited by its vibrations. It is also essential that, whatever instrument is employed, it shall be so constructed as to readily admit of *localizing the treatment.* This, and the other features above indicated, are not only desirable but absolutely imperative if the highest possible success is to be hoped for or expected in this method of treatment. Aside from exceptional cases, such as insomnia or general nervous depression, where the entire spine should receive mild stimulation, treatment will be much more satisfactory and effective if it is localized or restricted to the particular part affected and to the spinal nerve centre with which it is connected and by which it is controlled. The general "shake-up" of the entire body, such as some vibration instru-

ments are constructed to give, is neither desirable nor productive of satisfactory results. It is to be apprehended that practical investigation by the profession of the theory upon which at last all forms of effective mechanical vibratory treatment must be based, has been retarded thus far, because so many instruments have been offered that were neither so designed nor constructed as to be capable of fulfilling the requirements that sound scientific principles demand.

CHAPTER XIII

THE PHYSIOLOGY OF PAIN

A CHILD, as it begins to unfold in consciousness, gradually learns the significance of words. Among the first few words of which it learns the meaning are *pain* and its correlative word, *hurt*. Pain stands at the dawn of each visible human existence and is liable to accompany it, more or less, throughout its continuance until its physical expression sinks into the shadows and the mortal form thus becomes lost to sight. But, after all, few if any of all the myriads who have suffered pain, know what it actually is. We are familiar only with the physical phenomena that have in our consciousness come to be associated with the word *pain*. Is that not really all?

Psychologically, great diversity of view still exists respecting the sensation of pain. Münsterberg and James, of Harvard; Nichols, Strong and Ward and other prominent psychologists, regard it as a simple *specific sensation*. Others of equal eminence, perhaps, challenge this view. The weight of authority,

however, would seem to classify it among the *sensations.*

Leaving the psychic or speculative side of the question out of further consideration, for our present purpose we are concerned only with its physical aspects. Assuming, provisionally, that it is a specific sensation, we all of us know pretty well, experimentally, what its physical characteristics are. From this point of view, the quality of pain may be expressed as dull, throbbing, sharp, massive, grinding, shooting, burning, chilling, boring, griping, shivering, creepy, itching and formicating. Pain does not, however, always maintain its qualitative distinctiveness, but frequently partakes of and blends into one sensation, several of the above enumerated qualities. We have no explanation of the varieties in the quality of pain — why it should be dull instead of sharp, and *vice versa.* Physiologists do not attempt an explanation of it, and very properly permit it to remain in the speculative realm, for the investigation of the psychologist alone.

Before proceeding to look at the *physical* causes of pain, it may be well, perhaps, to briefly refer to two views held in respect to the significance or mission of pain. They are both really psycho-physical in their nature, al-

though physicians pretty generally regard them as essentially physical both in theory and in their practical application.

It may be said, then, with substantial accuracy, that there are two psycho-physical theories by which the significance of pain is explained.

The first and most generally accepted view, is the economic or biologic theory. According to this view, the mission of pain is beneficially protective, inasmuch as it is designed to give warning, by signalling to the central intelligence, of the danger to the physical organism in some of its organs or component parts. Pain thus becomes the instrument through which danger-signals are thrown out against perilous overstimulation in one way or another.

The other and less popularly received theory, but entertained by some writers of eminence, notably among whom we find Marshall, Leverette, and Füke, is that pain is the expression of the *quality* of the *activity* of the various organs or parts of the organism. For example, when the activity of an organ is inefficient, it gives rise to a sensation of pain. In other words, pain is experienced whenever the physiological reaction which determines a specific stimulus, is less in amount than the energy of the stimulus. It is highly probable that

both these theories are substantially correct, and that neither is wholly or exclusively so.

For the purpose of better elucidating the subject which forms the central purpose of this book, it is both interesting and important to inquire *how* pain is communicated, — by what channels or avenues, and what are their locations, in the body?

It may be said, in passing, that it has been claimed that there are special fibres which communicate pain, called "pain-nerves." Their existence has been argued with much show of plausibility, but the theory has not thus far won very much favor.

The theory, however, of the existence of a pain-centre in the body, as exploited by Witmer and others, finds a wider reception, perhaps, though that is far from being generally held as true. Upon this point, Witmer says: *

"It is my opinion that we are just as much justified in a tentative assumption of the existence of a pain-centre as in that of a centre for any other specific quality of sensation."

But the more important question for present consideration is as to whether there is a *special* path for the conduction of pain, and, if so, *where* is it located? It is believed by good authority that there is such a path, and

* Twentieth Century Practice of Medicine, Vol. II, p. 940.

that its location is in the *spinal cord.* This statement is submitted as a premise. Support is found for it, however, on page 935, Vol. XI, 20th Century Practice, already cited, where Dr. Lightner Witmer, in discussing this point, says:

"The evidence all seems to point to certain tracts in the spinal cord possessing specific pain functions. The gray matter of the cord is a specialized tract for the conduction of pain stimuli for a short distance above the segment of the cord which contains the nerves of the peripheral distribution. This tract, whatever its exact course may be, can be considered a spinal pain-organ. * * * The peripheral nerves stimulate this central pain tract or organ under certain conditions that depend upon the intensity, the duration, mode of application, and intermittency of all peripheral stimuli. In common with the nerves from the periphery, the viscera also refer excessive stimulation into this pain-organ of the spinal cord. * * * In peripheral reference, therefore, I believe that the pain-tract must be assumed to be excited in visceral disease, part of the stimulus referring into the pain-tract, occasionally also into the temperature-tract, but the other tracts may be acted upon by the stimulus, and these contribute to the localization of the pain quality.

These tracts must be supposed to be conjoined at each segment where they enter the cord, but afterwards separate. In each segment, therefore, we have a pain-tract capable of receiving stimuli from the afferent fibres of the area of segmental distribution as well as from the internal organs, trophic nerves, and so on."

And again, on page 940 of the same work, Dr. Witmer summarizes his contention as follows:

"6. There is a specialized pain-tract in the spinal cord which is certainly constituted in part by the gray column, and which may be composed of a part of the gray column on both sides, including the commissure and a part of the lateral tract. Into this pain-tract, nerves from the sympathetic system and from the internal organs, together with all specialized nerves from the periphery, discharge their stimulation when this is relatively intense. The intensity necessary to bring about this discharge may be that which is sufficient to overcome the resistance offered by the tract. * * *

"8. There is warrant of justification for considering the pain-tract in the spinal cord as the spinal nerve organ of pain, which, together with the *hypothetical* specialized cortical centre, constitutes the specific organ of pain.

"9. Any part of this central pain-organ

may be stimulated in the cortex *or below it,* either by stimuli discharging into it through normal physiological processes, by spinal or cortical association, by irritation due to disease, and perhaps by a vascular disturbance within the central nervous system."

Brown-Séquard, Gad and Heymann, all hold that the gray matter *in the cord* is alone responsible for pain conduction.

Dr. Mackenzie asserts that reflex alleviation of pain in central organs could be produced by counter-irritation of the periphery and cord.

Of more immediate practical importance than the question of its quality, character or even the tract of transmission, is that of the immediate physical causation of pain, and how it is occasioned. Beyond the very general and at the same time vague notion that it is due to interference in some way with the orderly and normal functionation of a nerve or nerves, very little is known as to the precise causative factors in the pain-producing process. It may be over-stimulation or under-stimulation; pressure due to hyperæmia; tumors or other adventitious growths; muscular contractures; concussion; shock, and many other causes known and unknown.

But after all known causes have been analyzed, much remains as to the causation of

pain for which we have no adequate and satisfactory explanation at the present time. For instance, the explanation of the cause of pain in malarial poisoning, in some of the forms of fugitive neuralgia, in anæmia, etc., are not altogether conclusive or satisfactory.

So, too, in reference to the explanation of the *modus operandi* of the *relief* of pain. In congestions and engorgements, it is generally believed that if an organ can be temporarily depleted — a circumscribed anæmia established — pain will, for the time being, at least, be relieved. On the other hand, a fixed condition of local anæmia has been held to be responsible for some of the most atrocious attacks of neuralgic pain! It would seem that the true explanation lies deeper and might possibly be found in some sort of irritable condition of the nerve-cell itself, and that for the production of an expression of pain, pressure or *mechanical* interference with nerve function is not absolutely essential.

For the benefit of those who may desire to pursue this interesting subject still further, recommendation is made of Hilton's *Rest and Pain;* Corning's *Pain;* Marshall's *Pain and Pleasure;* and Witmer's essay on *Pain,* in Volume XI of 20th Century Practice, previously cited in this chapter.

The purpose of the consideration to which this chapter is devoted, is a practical one. In the chapter on the Spinal Cord, the statement was made that it was *the index* of *irritative disorders in distant viscera* or areas; that disease in remote parts of the body would be found associated with sensitiveness to pressure over the nerves in the cord governing and connected with those parts. Dr. Mackenzie, it will be observed, practically affirms the same thing. The natural corollary of Dr. Witmer's statement, quoted in this chapter, lends support to this proposition. Its accuracy may be easily proven by personal experimentation. Of even still more practical importance, however, is the fact *that the spinal cord contains the pain-tract of the body;* that all sensations of pain from whatsoever quarter, must pass over this tract. In the chapter on mechanical vibration, the statement was made that pain may be inhibited through mechanical vibration applied deeply over the spinal nerve or nerve-centre controlling the organ transmitting the painful impulse. It was further stated that pain could be more effectively inhibited by applying the pressure at the centre rather than the periphery, or at any point between the two extremes, even though the painful impulse is initiated at and transmitted from

an area remote from the controlling centre. It was also stated in the preceding chapters that the viscera have their nerve centres in and may be reached through, the spinal cord. From what has been set forth in this chapter, in conjunction with that in previous chapters, the rationale of the inhibition of pain through the application of mechanical vibration to nerve-centres, particularly of the cord, becomes, it is confidently believed, intelligible and clear. In no other way and by no other means, can this result be so directly reached. It is a method both direct and natural. Unlike the inhibition produced by morphine and other narcotic drugs, the entire nervous mechanism of the body is not thereby depressed and benumbed with more or less temporary if not permanent, disturbance of *all* its organs and functions. With mechanical inhibition, on the contrary, the process of inhibiting pain may, for the most part, be localized and other parts of the body thus be spared from a visitation of evils "that we know not of" as the price of relief from local or circumscribed pain. Narcotic drugs have, in the past, rendered beneficent service in the relief of pain and suffering. All honor and gratitude is fairly their due for the blessed ministrations they have rendered, despite their disagreeable and

frequently injurious sequelæ. But, it is submitted, in conclusion, mechanical vibration, which renders possible and practicable *localized* inhibition of pain, is the veritable "bow of promise," announcing the dawn of a new and better era in the therapeutic process of analgesia, and in general therapeutics as well.

CHAPTER XIV

CONCLUSION

As announced at the outset, the purpose of this book is to explain the theory and practical application of treatment by mechanical vibratory stimulation. In pursuance of this purpose, the endeavor has also been made to show that the treatment is capable of stimulating to normal activity (when either deficient or excessive) the principal functions of the body. In order to demonstrate that the treatment is rational and scientific, and to formulate a system by which it could be intelligently applied to various abnormal conditions, a somewhat generalized review of the leading physiological functions has been given. This, it was hoped and believed, would obviate the necessity of considering the etiology, pathology and treatment of each disease according to the order of their arrangement in the standard textbooks. It was assumed that the practitioner, having in mind the leading principles governing physiological functions and their relationship to mechanical stimulation, would be better prepared to successfully apply the

treatment than if it were arbitrarily or specifically stated in connection with each disease. The diagrams, especially the frontispiece, showing the spinal nerve centres, will, it is hoped, be found useful in enabling the busy practitioner quickly to decide which nerve centre it is desirable to stimulate in order to affect a particular area or organ.

Without materially deviating from the original plan of this work, it has been thought advisable to submit the following regional résumé of the spinal nerve centres governing the different areas and organs of the body embraced therein.

REGIONAL RÉSUMÉ

of areas in the spinal column from which nerves originate that control and influence the action of various organs and parts of the body.

HEAD.

Brain. From 2d to 8th dorsal.

Eye. At the Atlas through the sub-occipital under the occiput; the 3d cervical just back of the transverse process, and on the head of the first rib.

Spinal nerves should be treated as low as the 5th dorsal. The centre is indicated by the sensitiveness of the nerve on deep pressure.

Treatment of lower part of Spine (as far as 5th dorsal) is mainly for nutritional effect. The cervical region is more in connection with the muscular action of the eye.

Ear. Over the middle cervical ganglion in front of the transverse process of the 6th cervical vertebra, between the sternomastoid muscle and the trachea. For middle ear, the neck, anterior and lateral, should also be treated from the 2d dorsal to the cranium.

THORAX.

Throat. Always treat lymphatics (glands) in the axilla on either side, as low as the 6th dorsal.

In tonsilitis, the liver and spleen ought always to be stimulated in addition to the local throat treatment.

Heart. From the 5th dorsal to the 3d cervical, and at the head of the first rib on the left side.

The liver and kidneys should also be well stimulated.

Lungs. From the 2d to 8th dorsal, both anterior and posterior, in connection with placing patient on his back and extending arms so as to raise the thorax by the pectoral muscles, and vibrating chest thoroughly while in this position.

ABDOMEN

Stomach. The 4th dorsal on both sides should be stimulated. Stimulation at the 4th dorsal, on the left side, will open the pylorus and usually relieve sick stomach.

By placing patient on right side, the stomach being filled with water, his knees well elevated, the operator can readily, with the left hand, raise the stomach and empty its contents into the small intestines, after hav-

ing opened the pylorus by stimulation of the 4th dorsal.

Treat 4th dorsal, solar plexus and pneumogastric.

Pancreas. Reach from the 8th dorsal and through the solar plexus.

Liver. From 6th to 9th dorsal, on right side, particularly at the angle of the ribs. In case of gall stones, treat liver, spleen and *pancreas.*

Spleen. Same as liver, except treatment should be given on left side.

PELVIS

Pelvic Region. 8th dorsal for suppressed menstruation; also at sacral attachment; through lumbar region.

In all pelvic troubles, the 5th lumbar is a very important point.

Ovarian Troubles. At the 12th dorsal, 2d lumbar, 5th lumbar and sacral attachments; also anteriorly over the organs themselves.

Urethral and Prostatic. At the 8th dorsal, 5th lumbar, and the sympathetic plexus in the groin just inside the anterior superior spine of the ileum, *deeply,* and through the rectum.

Gonorrhœa should be treated through the lymphatics of the groin, also throughout the lumbar and sacral region.

Spermatic Cord. 8th dorsal and 5th lumbar.

Bladder. 5th lumbar and sacral nerves; and through rectum in males.

Ureters. Throughout the lumbar and sacral regions.

LOWER EXTREMITY.

Femur. Nutrition to the leg is controlled by the sciatic nerve, which originates as high up as the 12th dorsal.

UPPER EXTREMITY.

Arms. Nutrition to the arms is reached from the 5th to the 7th dorsal.

GENERAL CONDITION OF NERVOUS SYSTEM.

Nervousness. Throughout the cervical and as low as the 8th dorsal vertebra.

Insomnia. From 7th dorsal to the occiput, and over the abdominal vessels.

Before applying mechanical stimulation, a definite idea of what is desired and how it is proposed to attempt to accomplish it should, of course, be formed. Consider, by way of illustration, the very prevalent disorder of constipation. Its causes are varied and numerous. They should be sought and, if possible, be

determined before treatment is instituted. All such cases will usually require treatment over the pneumogastric for the purpose of stimulating peristalsis, and over the splanchnic for its nutritional effect, and in the case of colitis, over the nerve supplying the colon. The additional treatment, whether of the liver and spleen and pancreas, over the sigmoid flexure, (where the nerves are proverbially inactive), the ovaries and uterus in women, the prostate in men, etc., should be directed in accordance with the conclusion as to the causation of the trouble.

Eye and Ear.

In treating the eye and ear, the muscles of the neck should be thoroughly relaxed, especially over the sub-occipital, and the 2d and 3d cervical nerves vibrated, in order to ensure free circulation. *In treating over the eye-ball, the stroke must invariably be shortened, and only very slight pressure used.*

Congestion and Inflammation.

In all local congestions, inflammations, varicose conditions, tumors, goître, gonorrhœa and rheumatism, the lymphatics contiguous to the affected area should always be stimulated, in addition to the proper spinal treatment, in

order to secure the best possible drainage. In the case of rheumatism, the liver, kidneys, spleen and bowels should always be freely stimulated.

Toxæmia.

The preceding recommendation also applies to auto-intoxications, general toxæmia and septicæmia where deleterious or poisonous products must be eliminated. The glands draining the infected area require (1) *tone;* and (2) *stimulation.* The first is secured through stimulation of the trophic nerves supplying them; and the second, by stimulation applied directly to the glands themselves.

Sprains.

Similar treatment is recommended in the treatment of the local inflammatory conditions consequent upon bruises and sprains. In addition to stimulation of the nerves governing the affected parts and the contiguous glands which drain them, the tissues themselves should also be gently relaxed by the direct application of the brush.

Neuritis.

In the various forms of neuritis, the centre in the spinal cord from which the affected nerve is given off, should be stimulated.

Sciatica.

Apply vibration at first with the brush, making very mild pressure over the origin of the nerve in the cord, and also to any other sensitive areas therein.

The immediate result will be (1) *relaxation* of the attendant muscular contraction; and (2) the production of local anæmia (?)* with relief of pain.

The pressure, while gentle at first, should be firm; and if patient is suffering acute pain at the time of treatment, it should be applied deeply for its inhibitory effect. After tolerance is once established, the ball should be used instead of the brush.

It will rarely be found necessary to treat the leg at all. Treatment at the origin of the nerve and perhaps over the spine, will be all that is required in most cases to relieve and *cure.*

Insomnia.

Insomnia should be treated by stimulating the nerves from the 7th dorsal up to the oc-

* Many authorities hold that it is not established that the production of local anæmia is an essential factor in the process, or that *it of itself* will relieve pain, even in congestive conditions, unless the congestion produces *tense pressure*, which is by no means its invariable concomitant. Evidently another explanation than the production of local anæmia must be found by which to account for the relief of pain in very many cases.

ciput, after which the intestines should be vibrated for its derivative effect.

General Nervous Irritability (Hysteria).

In conditions of general nervous irritability, where the immediate cause is not apparent, mild stimulation with the brush should be applied throughout the entire length of the spinal column.

Neurasthenia and Melancholia.

In neurasthenic conditions where excessive fatigue is a prominent feature, stimulation through the splanchnic region and upper spine, will be found to afford great relief.

Stomach.

In treating disorders affecting the stomach, stimulation should be applied to the pneumogastrics along the sides of the neck, to the 2d to 5th dorsal nerves, and over the solar plexus by deep pressure.

Liver.

The liver should be treated with the ball applied to the spinal nerves from the 5th to the 9th dorsal, and with the brush deeply over the intercostal spaces both front and back.

Kidneys.

The vagi have great influence over the nutrition of renal tissue and should be stimulated.

Stimulation should also be applied just below the 11th and 12th ribs, and vibration applied deeply anteriorly directly over the kidneys.

Bladder.

Apply ball deeply to the 5th lumbar and the sacral nerves; also to external iliacs as they cross the posterior superior spine of the ilium. This treatment will almost invariably relieve irritation at the neck of the bladder and favorably influence almost every other form of bladder affection.

Prostatic Irritation and Enlargement.

This should be treated from the 8th dorsal down to the coccyx, with the ball applied to the perineum immediately in front of the rectum, after which the rectal attachment should be applied directly to the organ *via the rectum.*

Diabetes.

In diabetes, remembering that the origin of the disease is now held to be in some yet unlocated portion of the nervous system, treatment should be applied both to the spinal and to the sympathetic nerves along the front of the neck. The liver should be thoroughly stimulated; and in case of inactivity, the kidneys also.

ciput, after which the intestines should be vibrated for its derivative effect.

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Stimulation should also be applied just below the 11th and 12th ribs and vibration applied deeply anteriorly directly over the kidneys.

Bladder.

Apply ball deeply to the 5th lumbar and the sacral nerves, also to external iliac as they cross the posterior superior spine of the ilium. This treatment will almost invariably relieve irritation in the neck of the bladder and favorably influence almost every other form of bladder affection.

Prostatic Irritation and Enlargement.

This should be treated from the 4th lumbar down to the coccyx, with the ball applied to the perineum immediately in front of the rectum, after which the rectal attachment should be applied directly to the organ *via the rectum.*

Diabetes.

In diabetes, remembering that the origin of the disease is now held to be in some yet unlocated portion of the nervous system, treatment should be applied both to the spinal and to the sympathetic nerves along the front of the neck. The liver should be thoroughly stimulated; and in case of inactivity, the kidneys also.

Biliary Calculi.

Strong stimulative treatment over the spinal area controlling the pancreas and spleen, will almost always relieve, and, if continued a sufficient length of time, *cure* the abnormal chronic condition upon which the formation of calculi depends.

Hemorrhoids.

In treating hemorrhoids, heavy stimulation should be applied to the lower lumbar and sacral nerves. The liver should next be vibrated, and then by means of an attachment for this purpose (which may serve for the vagina also) inhibition should be applied directly to the rectum. The relief is usually very marked, and a cure in many of the worst cases may be confidently expected from this treatment.

Scoliosis.

The results of treatment by mechanical vibration in spinal curvatures, have been surprisingly prompt and satisfactory.

Treat, first, with moderately deep pressure on the side towards which the column deviates, with a view to relaxing the contracted muscles and thereby removing irritation to the nerves consequent upon the contractures. The rubber ball should be used for this purpose.

Next treat on the opposite side of the column, with a view to stimulating increased blood supply to the nerves of nutrition. This will materially aid in developing tone and strength in the partially inhibited muscles.

The improvement, both locally and in general systemic tone, is likely to be very pronounced from the first treatment. Keep the cases under occasional observation for six months or a year after a cure seems to have been made, in order to guard against possible relapses.

Goitre.

There is no treatment within the writer's knowledge that affords as satisfactory results in all forms of goitre (even in the exophthalmic variety) as mechanical vibration.

Find the points of sensitiveness in the cervical or dorsal regions, and treat them with the rubber ball, using deep, firm pressure.

Next thoroughly treat, with the brush, the lymphatics of the axilla on both sides; then the liver and spleen; and then, with the brush, vibrate the goitre, using moderate pressure while *gently elevating it.*

Mesenteric Glandular Flushing (Dypsomania and Morphinomania).

Particular attention is invited to a method

of treatment which may be new to the reader, but which he is assured is as effective as it may be novel. The treatment is especially commended for dypsomania and morphinomania, in which the secretory glands of the body are either engorged or depleted. In the first condition hot water should be used, inasmuch as it causes the mesenteric glands to more freely respond; while in the second condition, either cold or hot water may be used, as the object sought is to supply artificially the moisture of which the morphine has deprived the parts.

The technique recommended for flushing the mesenteric glands is as follows: The patient should drink at least a pint of water, and then lie on his right side, knees well elevated. Vibratory stimulation with the ball should then be applied to the spine between the 4th and 5th dorsal vertebræ, using firm and tolerably deep pressure. This is recommended for the purpose of relaxing the pylorus. The application should be made for about one minute. Next place the hand over the abdomen, just below the stomach, and exert heavy *upward* pressure, with a view to elevating the stomach. When this is accomplished, the contents of the stomach will be rapidly discharged into the abdomen, without

much absorption taking place through the gastric glands. The next and final step should be stimulation of the splanchnic nerves, for the purpose of accelerating absorption through the mesenteric glands.

This little manual operation may be repeated with advantage several times, until from two to three quarts of water are thus forced into the intestines.

It will be found that this treatment will (1) markedly decrease the patient's craving for alcohol or morphine; and (2) relieve much of the physical discomfort and suffering attendant upon their withdrawal.

Mental Diseases.

In almost if not all *mental* diseases (regardless of their pathology or names), the areas in the spinal cord in which the vasomotor nerves supplying the brain originate, as well as those in the splanchnic area, will, on inspection, be found to be irritable or abnormal. This condition will be disclosed by hyper-sensitiveness to moderate degrees of deep pressure. In addition, there will be found marked contraction (and usually atrophy) of the deep muscles lying in the areas above mentioned.

In diseases of the cortical substance, there

is usually also impairment of the nutrition of the cord in the spinal areas now under consideration. This is believed to be due to the contractures of the deep muscles in those regions, and which affect the brain cells in two ways: first, by impairment of cortical nutrition; and, second, through the action of certain poisons (probably ptomanic in character) generated in the mesenteric glands of the intestines, in consequence of their inactive functionation. The lowered activity of these glands is believed to be due to insufficient or impaired nerve supply.

The indications for treatment, in view of the conditions above noticed, become at once apparent. The deep tissues in the affected areas of the cord must, first of all, be relaxed. This will permit of an increased blood flow to these parts, and, by relieving pressure, enable the nerves to regain their lost tone, which, in turn, will increase the nutrition to the brain and suspend the further production of poisonous matter in the mesenteric glands.

It will be observed that in the application of mechanical-vibratory stimulation to the vaso-motor area in the cord supplying the cortex, and to the splanchnic regions, three indications are fulfilled simultaneously. That is to say, by (1) treating the muscular con-

tractures lying in these areas they become relaxed; (2) the vaso-motor tone is consequently restored, ensuring a more efficient as well as an equable blood flow to the brain; and (3) the nerves of the mesenterics receive the stimulus necessary for their normal functionation, thus inhibiting the further generation of poisonous substances which injuriously react reflexly upon the brain cells.

If these suggestions could be practicalized in the manner above indicated, there is abundant reason for believing that very many of the supposedly *incurable* cases of mental disease now isolated in asylums and sanitoriums might be cured and the unfortunate victims restored again to their former activities and their friends, "clothed and in their right minds." It is to be hoped that at no very distant date, individual experimentation will have progressed so far along the lines above indicated, as to lead to a demand from the profession for the adoption and utilization of this method of treatment in all the leading hospitals for the insane.

Degrees of Treatment.

Stimulation is produced by a medium stroke and light pressure. This is the degree of treatment that will be found the most effica-

cious in the majority of cases for increasing the blood supply to a given part and improving nutrition and the general tone. *It is always applied with the brush.*

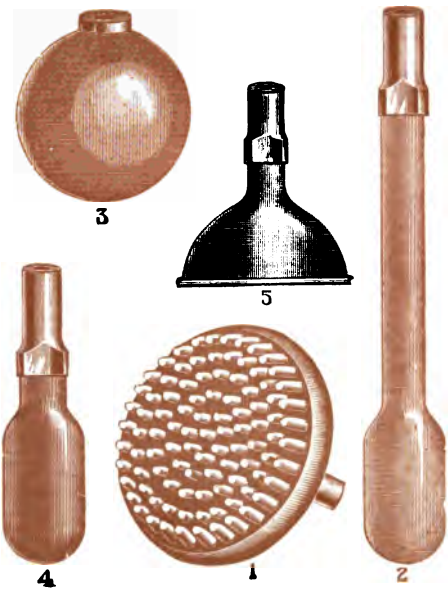
Vibratory stimulation will be found preferable where there is pronounced inaction or atony. It should be applied to the spine by means of the ball. For this degree of treatment, tolerably deep pressure is advisable. *This is not advisable generally for hypersensitive patients,* although some cases of hysteria have been greatly benefited by it.

Vibration is produced by a heavy stroke and *deep pressure.* It should only be applied to inhibit a nerve that is communicating a sensation of pain, and to relieve congestion or engorgement in an organ. *The ball must always be used for these purposes.*

Patients should always remove all tight-fitting clothing, especially from over the back and chest, and lie down while being treated, preferably covered with only a thin garment. Corsets must be removed during treatment.

The three degrees of treatment, in their application to the cord, should be applied between the transverse processes of the spinal vertebræ, which are immediately over the posterior division of the spinal nerves. The impulse thus set up is conveyed toward the

Plate VIII.



1. Rubber Brush.
2. Rectal and Vaginal Attachment (rubber).
3. Rubber Ball.
4. Throat Attachment (rubber).
5. Eye Cup (rubber).

Diagram showing the various attachments recommended for use in the application of mechanical vibratory stimulation to the various organs and cavities of the body.

cord, and is communicated at the juncture of the anterior and posterior roots in the intervertebral foramen, to the anterior division of the spinal nerves, and through the rami communicantes, to the sympathetic nerves lying on the head of the ribs. See Plate VI, opposite page 78.

Length of Treatment.

Individual judgment, based somewhat upon a knowedge of the temperament and personal idiosyncrasies of the patient, as well as upon the condition of the local area affected, will have to be relied upon to determine the length of time that treatment shall be applied to a given point. Only suggestions that will be found in the majority of cases to be *approximately* the best, can here be given. Experience has satisfied the writer that there ought to be considerable difference in the duration of the treatment as well as in the degree of pressure and length of stroke, when applying *stimulation, vibratory stimulation,* and, naturally, still more, when treating for *inhibitory* effects by vibration alone.

In *mild stimulation,* the application should be from three to seven seconds at a given point.

In *vibratory stimulation,* the application should be from eight to twelve seconds.

For *inhibitory effects,* the application should be from fifteen to twenty seconds.

It should be constantly borne in mind that *over-stimulation,* while not permanently harmful, is never desirable, and tends to arrest or retard the curative process.

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INDIANA HAND VIBRATOR.

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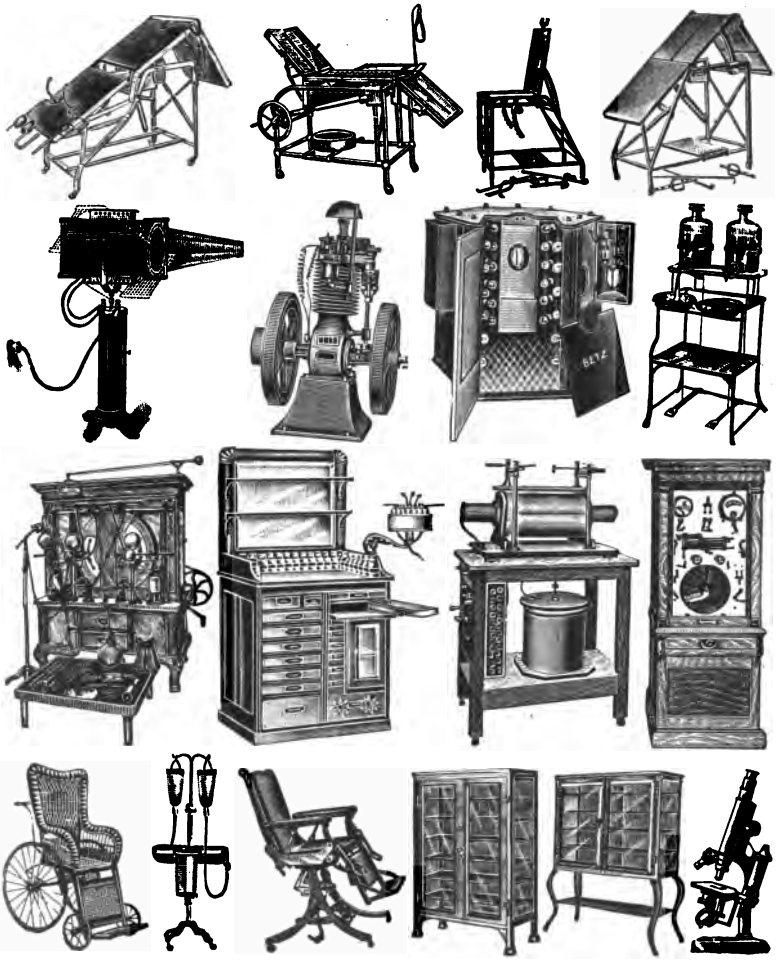


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